

AUSTRALIAN **Electronics** **ENGINEERING**

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FEBRUARY 1996



**Tektronix' new
affordable TDS-300
series high-speed
digital scopes with
FFT & disk drive**

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Test & Measurement

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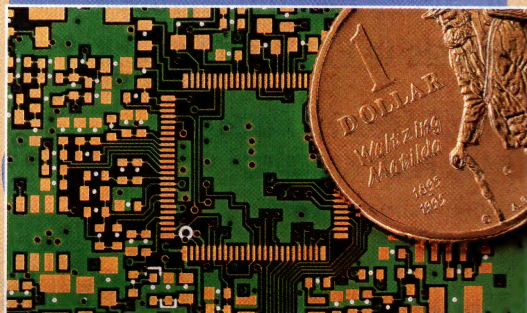
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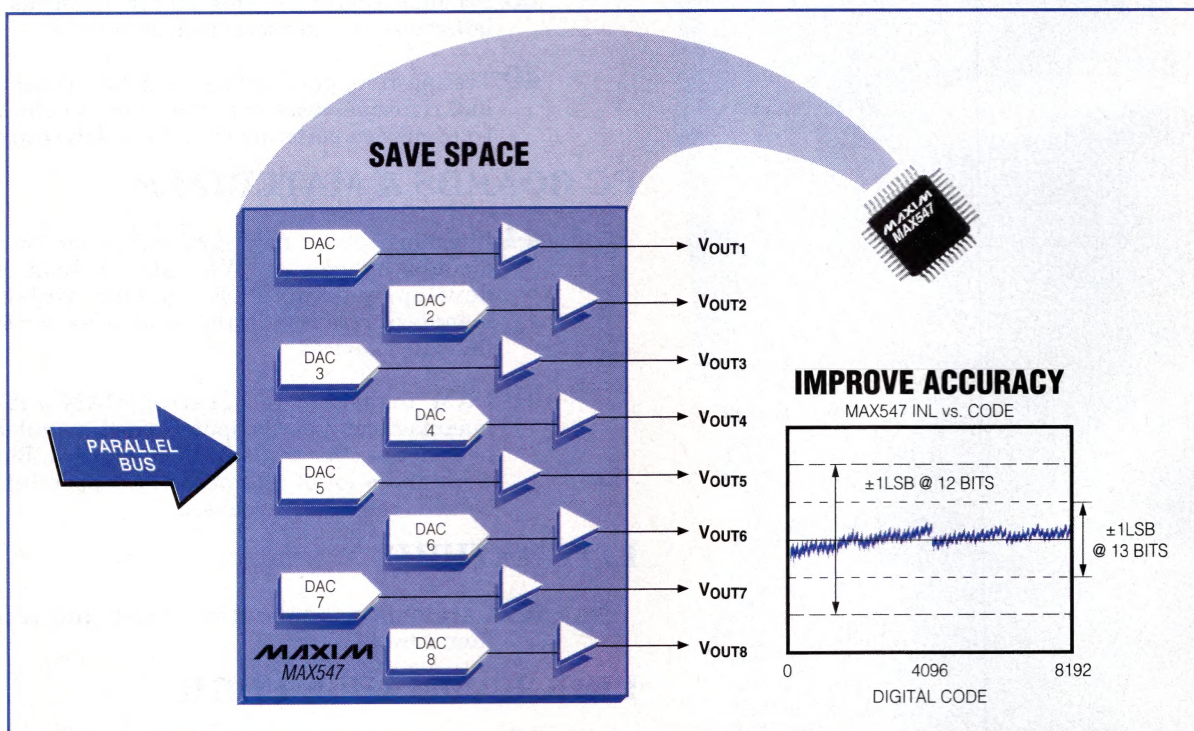
We look at developments in PCB surface finishes. See page 44.

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FROM THE EDITOR'S DESK



Start talking

In this month's special feature on printed circuit boards starting on page 43, we present two articles looking at different aspects of PCB manufacturing — surface coatings (*Finishing school*, page 44) and computer-aided manufacturing (*CAM together*, page 50).

While these two articles look at very different aspects of PCB manufacturing, it is interesting to note that both cite the lack of communication between different sectors of the electronics industry as a major cause of problems — in particular the lack of interaction between PCB designers, manufacturers and assemblers.

The sentiments in these particular articles come from the PCB manufacturing sector, but I've heard similar comments in the past from both designers and assemblers. Manufacturers complain that designers and assemblers don't talk to them, assemblers are worried because the PCB manufacturers and designers seem distant, and the designers claim no-one gives them any manufacturing feedback. Everyone sees the need to talk, but no-one is talking. Not to each other, anyway!

It seems to me that what we have here is a collective ego problem and a fear of treading on someone else's professional turf.

For example, a PCB manufacturer may find problems with a board design that make it difficult to manufacture. The designer is oblivious to the problem but the manufacturer won't tell him/her for fear of being seen as incompetent or a whinger, and perhaps losing the job. Perhaps some designers really do react this way.

The point is that everyone acknowledges the problem exists, but nobody seems to know what to do about it or how to begin to open channels of communication.

I'm afraid I don't have any magic solutions to the problem, but I do know that the barriers must be broken down if the electronics manufacturing industry in Australia is to progress.

The accelerating advances in design and manufacturing technologies may themselves provide the force necessary to bridge the communications gap. Ten years ago the processes were simple enough to allow the various sectors to get away with working in isolation from each other — you just did your thing and passed the product on, working around problems as they cropped up. But today design, manufacturing and assembly tolerances are becoming so critical that designers, manufacturers and assemblers will be forced to collaborate just to get a working product out the door.

Companies which try to work in isolation simply won't be able to survive. Companies and customers that deflate their egos a little and start talking now will get a head start on the pack.

This age of communications is not only exciting in the technologies it heralds, but also in the links it will build between previously disparate sectors of the electronics industry. □

Stanilite stung

Shortfalls in revenue expectations are cited by Stanilite as the major reason for first half losses of \$11.7 million reported by the company late last year.

Stanilite's Finance Director David Fayle rejected suggestions that the company has overextended itself, and denied that Stanilite's recent rights issues were in response to the shortfalls. When asked if Stanilite's suppliers were being paid, Fayle acknowledged that some suppliers had experienced delays. He would not comment however on whether Stanilite had made any claims on insurance with the Export Finance and Insurance Corporation (EFIC).

Expected first half revenues of \$75 million fell short by approximately \$45m. An estimated \$19m of the difference was a Defence contract not won, and follow-on orders which were expected but didn't materialise. Another \$15.5m of the shortfall was from delays in payment from contracts in Argentina and India, expect-

ed to come in in the near future. A further \$8.5m of the difference was for orders originally forecast to be received before the end of 1995 in north Asia, the Middle East, Europe and the Pacific. Contract negotiations are continuing on these. Other costs such as restructuring, R&D and increased overheads make up the total of the unexpected profit reversal.

The biggest contract won by Stanilite in 1995 was a \$37.5 million deal to provide cellular phones to Russia. However there have been difficulties in getting the equipment into the country, unprepared installation sites, delays, and great difficulties in receiving payment; a Stanilite delegation to Moscow has come to an agreement for revenues to be received on a monthly basis rather than on subscriber uptake.

The company hopes to return to profitable operation during the second half to June 1996. □

Engineers' oral history recorded

Australia's engineering history is being recorded in an important and accessible way by the Institution of Engineers' Oral History Program.

The Institution has recognised that engineers now in their 60s and 70s have been involved in the greatest technological and social changes the world has ever experienced. So far, the life histories and work experiences of 60 eminent Australian engineers have been recorded in interviews, and 45 of these tapes have been donated to the State Library of New South Wales for public access.

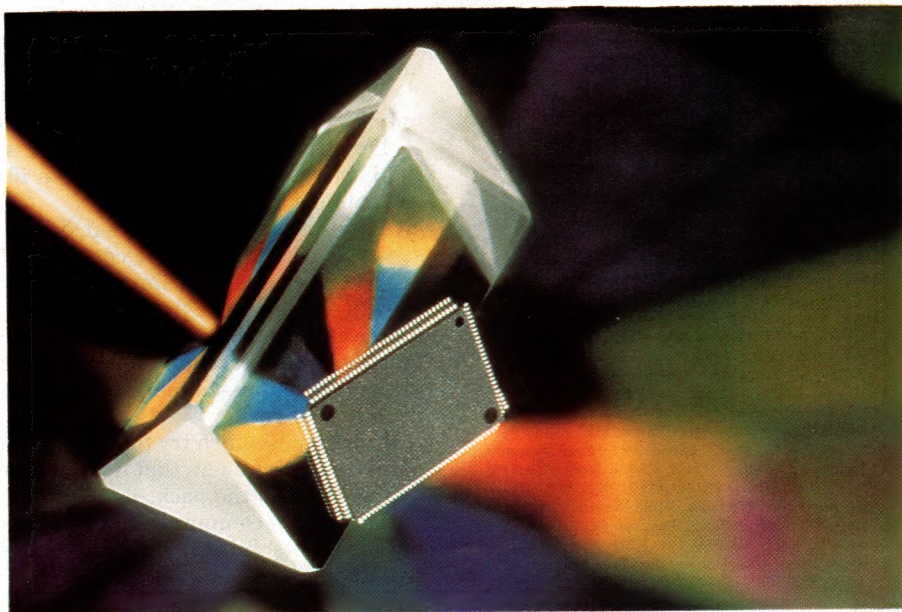
The interviews include such engineering greats as Warner Kuttner who contributed to the development of the first major wind tunnels, Professor John

3-D RAM road map unveiled

Mitsubishi Electronics has unveiled a road map for the future development of its 3-D RAM family of products.

In July 1994 Mitsubishi, which is represented in Australia by Adilam Electronics, released its first generation 3-D RAM, developed with Sun Microsystems. Employing an innovative frame buffer architecture for 3-D graphics, it was claimed to provide a tenfold increase in performance at a cost comparable to video RAM.

Steve Forman, Mitsubishi's strategic product marketing manager said "Market response to the 3-D RAM has been outstanding, reflecting the current market shift from 2-D to 3-D graphics systems...we anticipate that by 1997 significant demand for 3-D graphics will permeate the 3-D marketplace." The device is used for engineering workstations, video arcade games and sophisticated simulations such as flight

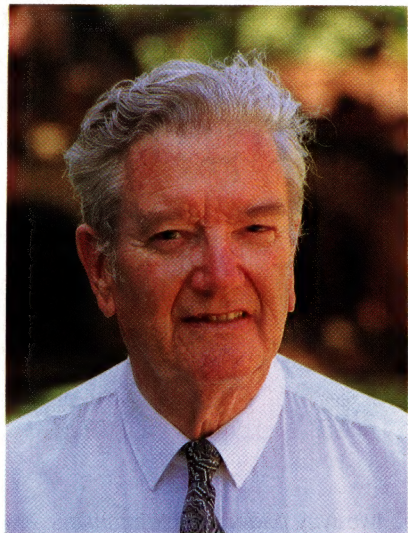


Mitsubishi "big plans for 3-D RAM"

simulators, and is manufactured with an advanced 0.5µm process and will perform a pixel-write operation in 10ns (100MHz).

3-D RAM II which includes all of the 3-D RAM functions plus a stencil function, is now being evaluated and volume production is anticipated for the first quarter of 1996. The third

generation will have a wide application base and will employ advanced 0.4µm technology to yield a very competitive die size. It will have all the features of the two previous versions, with the added functionality to support 10-bit pixels and the standard Open GL blending functions. Samples are slated for the last quarter of 1996. □



Warner Kuttner (top) and John Bennet: "as much a part of our heritage as the Sydney Harbour Bridge."

Bennet who was involved with the development of the first computers in Australia, and Neville Whiffen, who alerted the Americans to the fact that their World War II equipment was not suitable for tropical warfare.

Stephen Branch, president of the Institution of Engineers presented the tapes to the State Library in November last year, saying "[These engineers'] lives and what they can tell us are as much a part of our heritage as the Sydney Harbour Bridge....By recording their stories, we have a chance of making that history not only more accurate and complete, but more revealing, intimate and human."

Michael Clarke, Chairman of the Institution's Engineering Heritage Committee, said the tapes are part of an on-going project and as more interviews are completed, they will be added to the collection at the Library. □

Philips Calibration Services is set to launch a new service 'mobile calibration' as part of an on-going strategy to increase its market share in the commercial calibration area. The new service will provide on-site calibration for companies that find it difficult to ship their instruments to a test house. Philips plans to launch the mobile service in February from its Sydney facility at Moorebank. □

Cabletron has acquired Standard Microsystems' Enterprise Networks Switching group for \$75.9m. The acquisition significantly expands Cabletron's presence in the Fast Ethernet market. □

The Federal government has announced the establishment of a new Perth-based Cooperative Research Centre (CRC) for renewable energy and related greenhouse gas abatement technologies. Senator Cook said "The CRC will focus on incorporating renewable energy sources into reliable electricity supply systems, ultimately contributing to the reduction of greenhouse gases." The government will provide \$15m over seven years for the Centre. □

The Federal government has announced its intention to fund five new CRCs. Funding of these additional centres will bring the government's total contribution to approximately \$1 billion once all 67 centres are established. The five new centres will be for advanced engineering, sports science, intelligent transport systems, textile technology and building construction technology. □

The Australian telecomms consultancy Consultel will open an office in Hanoi in the next two months to help Australian firms gain a market foothold in Vietnam's telecomms infrastructure development, with a view to market leadership. The company is also organising a defence communications and electronics exhibition in Hanoi in the first half of this year. □

Rockwell has announced it has renamed its telecommunications business segment Rockwell Semiconductor Systems. The name change recognises the semiconductor technology base of the segment's business, as well as the value-added "systems-on-a-chip" nature of its product offerings. □

Amtron Australia has been awarded a Standards Australia DesignMark for its RFI-shielded backshells. The DesignMark assessment panel concluded "The Amtron RFI shielded backshell is an innovative, well-engineered product solving the dual problems of physical adaptability and undesirable electromagnetic interference emissions." □

Olex Cables, with the help of Austrade, has broken into Japan's tightly integrated power production and distribution industry. Okinawa Electric has placed a \$230,000 trial order with the company which could lead to additional sales to Okinawa and to other power companies throughout Japan. Olex Pacific regional manager David McNamara said "Olex regards this sale — our first to a utility in Japan — as being very significant for us and for all Australian suppliers to the power industry. □

Telstra has awarded a major contract to Skandia Electronics for the supply of field strength meters, devices used to validate the quality of the signal being delivered to the customer's set top decoder. It is planned that all Telstra teams installing Foxtel will use a calibrated field strength meter. The contract will run into a possible \$2-3m in extra sales for the company over the next two years. □

Computer bounty retained but changed

The electronics manufacturing industry breathed a sigh of relief at the end of last year when the government announced it would continue the so-called 'computer bounty', which gives rebates to various technology-related enterprises for value-added expenditure.

Two major changes have been made however to the bounty's structure. At the end of 1996 the bounty's current rate of 8% of factory cost will be dropped to 5%, which the government says is broadly in line with the general rate of tariff for manufacturing industries; and R&D will no longer be claimable under the bounty, a move which will reduce the value of the bounty by up to \$30 million a year.

The Australian Telecommunications Industry Association (ATIA) has approved of the modifications, stating they would ensure that the bounty's funds are more appropriately directed to value-added manufacturing activities.

The bounty is expected to inject around \$250 million into the electronics sector in the next five years.

Senator Peter Cook, Minister for Industry, Science and Technology said the real winners out of the decision to continue the bounty were the towns and cities which had already invested in the electronics industry, in particular Sydney, Brisbane and Adelaide, and Wangaratta and Ballarat in regional Victoria.

"The computer bounty will enable manufacturers of electronic products to invest more in product development and this in turn will help Australian companies capture a greater share of domestic and export markets," Senator Cook said.

The \$80 million a year bounty was in jeopardy after an independent report by the Industry Commission recommended it be scrapped. Introduced in 1984, it provided 25% of factory cost to domestic producers of eligible hardware and some software. The rate was later reduced to 8%. In 1993-94, 688 companies claimed the bounty. □

The NexNet big thing in paging

The humble pager, once king of the professional shirt pocket, has lived largely in the shadow of the ubiquitous mobile phone of late. But the pager industry is fighting back with the recent launch of a new weapon in the personal communications war — a two-way paging system that can also be used as a tracking and positioning system. Going by the name "Twager", the two-way pager is being brought to Australia by the INC Group.

The system will piggy-back on the cur-

rent paging infrastructure to allow a more cost effective introduction. Messages to the paging device use the current paging system, but with the addition of a command control centre linked into the system, the Twager user can respond to a page by sending one of a number of pre-programmed messages back to a telephone, fax, computer, or another pager.

The Twager has a library of 500 pre-programmed response messages, though only 16 of these can be stored in the unit



The two-way pager and automatic vehicle location device, expected to become operational this year.

at a time.

As well as a paging system, the Twager can also be used as a position locating system. When a message has been sent by a Twager device, its location can be calculated at the control centre using triangulation. At less than half the cost of installing a satellite positioning system, this feature is expected to be popular with vehicle fleet operators. When installed in a vehicle for positional use, the automatic vehicle location device is concealed in the body of the car and comprises a standard paging receiver, a spread spectrum transmitter and concealed antenna.

As an anti-theft device it can stand alone or be connected to a current alarm system, and can interface with an ignition or engine operation sensor to activate the horn, lights etc. Once it is tripped the device is activated remotely and the vehicle can be tracked.

A three month pilot will be run in Canberra early this year using 500 pagers distributed amongst the three pager carriers - Link Telecommunications, Hutchison Telecoms and Telstra. □

ON THIS MONTH'S COVER

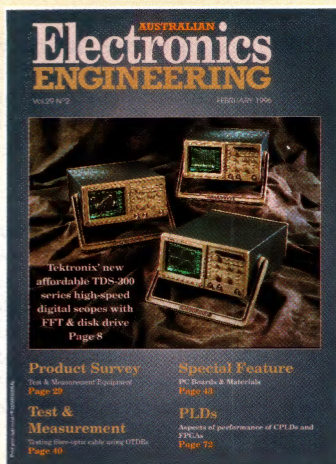
With the breakthrough new TDS-300 Series, **Tektronix** and **Emona** redefines the price/performance benchmark in oscilloscopes. Numbers tell the story. With sample rates of 500MS/s, 1 and 2GS/s for scopes with bandwidths of 100, 200 and 400MHz, Tektronix takes you to the highest level of performance — "Digital Real Time" (DRT).

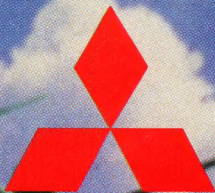
DRT — a Tektronix exclusive — lets you instantaneously display the minutest glitch and jitter in both single-shot and complex waveforms simultaneously on both channels.

At this level of reality you'll see things the other scopes can't even capture. The new TDS-300 series also offers FFT for real-time spectral display, and disk drives for push-button storing of waveforms and data — features which others often don't even offer.

The biggest breakthrough, though, is the price tag. The TDS-300 series starts at only \$3,700 (ex-tax). For this price you get a level of performance earlier reserved for scopes of twice the price. Contact **Emona Instruments** for more details or an obligation-free demonstration. [1270](2)

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The Fieldbus Foundation, an international non-profit body whose purpose is to aid development of a single international interoperable fieldbus, has accepted a set of hardware and software tools developed by National Instruments that will allow the Foundation to proceed with alpha and beta tests of its fieldbus protocol. National Instruments says these devices will greatly assist the Foundation to deliver to users a proven protocol supported by virtually every major process control supplier worldwide. □

The US electronics manufacturing services industry has been given its own classification under the new Standard Industry Classification Code (SIC) system. The Institute for Interconnecting and Packaging of Electronic Circuits (IPC) has fought hard in recent years to have the manufacturing sector given its own code. The establishment of a separate classification code is significant as government reports from these classifications form the basis of much business in America. □

NHP's head office in Melbourne, and the Sydney and Brisbane branches achieved Quality Certification from NATA in October last year, to standard ISO9002. The Perth and Adelaide offices will be ready for audit early this year, with all other branches scheduled for audit by mid-1996. □

Tektronix and Texas Instruments have announced they will collaborate on the definition of a codec architecture supporting MPEG 4:2:2 profile. The standard delivers unparalleled flexibility through the ability to make trade-offs between levels of compression and bit rate while maintaining video quality. It is expected the collaboration will lead to future development of products based on this architecture. □

Comlinear Corporation, which makes a range of analogue ICs, has been acquired by National Semiconductor and will become part of its analogue products division. National Semiconductor is distributed in Australia by Hartec who will now be handling Comlinear products, previously distributed by Zatek. □

Robotic Vision Systems Inc (RVSI) in the US has been awarded a patent for a technique for high speed 3-D scanning of semiconductor packages, including BGAs, micro BGAs, land grid arrays and column arrays. RVSI said the significance of this patent award is that it would make it difficult for a competitor to develop a high speed non-contact 3-D scanning technique for BGA substrate inspection that allowed precise substrate warpage measurement and did not infringe this new patent. □

Interactive TV gathers global momentum

Interactive TV is gearing up worldwide, with the latest developments being the formation of a Japanese body late last year for the promotion of a new interactive TV system, and Hewlett Packard's agreements with two major telecommunications companies to develop interactive TV services in Hong Kong and Germany.

In Japan, sixteen major companies in the electronics, telecommunications and advertising industries have formed the Intertext Consortium to speed the early development of a new interactive TV system, with the goal of starting broadcasts this year.

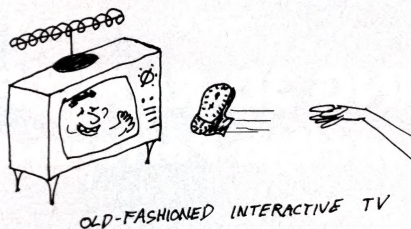
The consortium will provide a forum for information exchange on the new interactive TV system, while promoting it to broadcasters, TV program production companies and advertising and marketing companies both in Japan and overseas.

Originated by Toshiba, Sony, Matsushita and Nippon Telegraph, the system will use the current terrestrial TV and teletext broadcasting system and standard telephone lines, which means cheaper installation and operation than fully digitised interactive systems.

The system consists of an interactive TV broadcasting system, network server, telephone lines and home-use TV receiver. The broadcasting system comprises an interactive program production system,

data storage system, TV program transmission system and multiplexing equipment.

The new system uses data codes left unused in current television signals to carry additional information which is fed to a dedicated decoder in the TV receiver which executes the commands. This approach is based on the vertical blanking interval (VBI) data broadcasting method, and works



as an extension to Japan's current system for teletext broadcasting. Using 4V BI lines, information can be delivered at a rate of approximately 5Kb per second. The system also incorporates a standard modem in its dedicated TV set or set-top box, which enables broadcasters to send additional information via telephone lines and allows viewers to respond interactively.

The consortium has stated it expects that TV set manufacturers will develop and commercialise sets which incorporate a dedicated decoder and telephone modem.

Set-top boxes will also be available for users who want to access the system using their current TV set. The consortium also expects that telephone companies will develop networking technologies for interactive information exchange.

The interactive system will be used for teleshopping, for quiz shows where viewers can participate using their remote control, and TV polling.

Hong Kong and Germany have also thrown their hats in the ring recently, with Hong Kong Telecom and Deutsche Telekom signing letters of intent with Hewlett Packard to provide the HP MediaStream server to deliver their interactive television services.

After 22 months of field trials, Hong Kong Telecom has plans to launch full interactive multimedia services in mid-1996, while Deutsche Telekom will be using the HP technology to conduct interactive TV trials in Stuttgart, one of six German cities trialling the service.

According to HP, its MediaStream server will transmit nearly 70 percent of the multimedia streams into homes participating in interactive TV trials and deployments around the world.

A July 1995 study quoted by Hewlett Packard estimated that by the start of this year 3.1 million homes worldwide would be connected to interactive TV services. □

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Senator Peter Cook speaking on December 13 at the Sydney launch of Optus Communications' 1995 Industry Development Report, congratulated Optus on meeting and exceeding its industry targets for the year in R&D, capital expenditure and Australian content. Optus' total expenditure in 1994/95 was 1984.1 million, 76.4% of which was for Australian content. Optus' total expenditure to date has been \$4714.1 million, with 74.1% spent on Australian content. This puts Optus well on target to achieve 75% Australian content by 1997. \$53.3 million was invested on R&D in 94/95, over 90% of which was undertaken in Australia. □

Cadence sues Avant! Corp for theft, conspiracy

Following extensive investigations, Cadence announced in December it had filed a complaint against Avant! Corp., formerly known as ArcSys Inc., and four individuals (all former Cadence employees) for misappropriation of trade secrets, copyright infringement, conspiracy, and other activities.

Avant! is a supplier of EDA software, as is Cadence. Cadence filed the complaint in the US District Court one day after the Computer Crime/Hi-tech unit of the district attorney's office conducted a search and seizure at Avant!'s Sunnyvale, California headquarters, pursuant to a warrant.

A leading semiconductor vendor independently compared products from the two companies and found more than 4,000 strings of characters that matched, and incorrect grammar used in identical places.

A temporary restraining order was issued by the US District Court to prevent the defendants from modifying or destroying any copy of computer code for any version of Avant!'s ArcCell products. It also ordered the defendants to notify Cadence within 24 hours of the location of all off-site storage facilities and all off-site copies of Avant! source code or object code.

Cadence alleges, amongst other things, that a search of one of the defendant's homes in November 1994 found proprietary Cadence code which had been stripped of Cadence's trademark and copyright notices and was in the process of being further modified; and that, in violation of US law, Avant! has been conducting a smear campaign against Cadence, a campaign they have dubbed "JFK", which one of the defendants has publicly stated stands for "Just F...king Kill" Cadence.

President and CEO of Cadence, Joseph Costello, said "We believe we have incontrovertible evidence that Avant! is a company built and sustained with intellectual property stolen from Cadence. Our suit alleges that Avant! and the individual defendants stole Cadence source code as part of a conspiracy to unlawfully gain immediate business advantage rather than compete fairly through legitimate means and hard work...The brazen and illegal acts alleged in our complaint leave us with no choice but to seek redress for our company, our employees and our shareholders."

The Santa Clara County district attorney's office is conducting an independent investigation. □

Philips boosts local IT&T

Philips has joined the Government's Partnership for Development program with an investment strategy designed to boost Australia's information technology and telecomms industries. It aims to generate \$713 million in new business activity through the partnership strategy.

The seven year partnership will involve Philips in design and development (D&D), strategic investment, technology transfer and export initiatives.

It will focus on core business and technology-intensive activities including public telecomms systems, broadband transmission systems, rural microwave systems, intelligent traffic systems, engineering systems, microelectronic components and industrial design.

The plan forecasts total D&D investments of \$95 million; exports of Philips' products, systems and services of \$364 million with a forecast of \$249 million over the term of the plan; and exports facilitated by Philips of \$254 million. □



Senator Peter Cook, Minister for Industry, Science and Technology with Philips Electronics Chairman and CEO Justus Veeneklaas who described the partnership plan as a "tremendous vote of confidence in Australia's future."

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Zatek has been appointed as the Australian and New Zealand distributor for **Microchip Technology's** range of integrated 8-bit microcontrollers and EEPROMs. □



Stewart Booth (left) of Zatek and Larry Ross of Microchip signing the distributor agreement.

Zatek has moved its Sydney operation to new premises. The new contact details are: **Level 4, 5 Belmore St, Burwood NSW 2134, tel (02) 744 5711, fax (02) 744 5527.** □

Singapore-based **Precision Circuit Manufacturers** has appointed a recently-formed company, *The PCB Company* based in Melbourne, as Australian distributor for its printed circuit board product lines. Products will be from single-sided boards up to 10-layer PCBs, with no minimum order requirements. Contact **The PCB Com-**

pany at 19 Eyre St, Westmeadows VIC 3049, tel (03) 9302 2621, fax (03) 9309 5984, and quote *Australian Electronics Engineering.* □

The Sydney office of *Huber & Suhner* has moved to larger premises to enable its three major divisions — Suhner Radio Frequency and Microwave, Radox Cables, and Suhner Fibre Optic — to consolidate activities in one location. The new address is: **42 Wattle Rd, Brookvale NSW 2100, tel (02) 9905 0000, fax (02) 9905 6378.** □

Another company to relocate recently is *Geolab Systems*, which has moved its Sydney office. New contact details are: **PO Box 6332, Silverwater NSW 2128, tel (02) 647 1600, fax (02) 647 1609.** □

Data and communications equipment supplier *Dataplex* has expanded to include a new branch office in Queensland. *Dataplex* has acquired its former distributor **Northern Datacom** in an agreement which will see former Northern Datacom employees retained to continue servicing the region. □

Measurement and control company, *Moog Australia*, has been appointed master distributor in Australia and New Zealand for German-based **Novotechnik's** range of linear and rotary transducers. □

KC Electronics has been appointed the Australian distributor for **LG Semicon (Goldstar)**. The LG product range includes memory, logic, linear, ASIC, MCU and CCD devices. *KC Electronics* has also secured the agency for **Minireel Components'** range of

surface mount components in 4 inch reels for low volume production applications. □

C&K Electronics of Sydney and *Jesec Switches Plus Components* of Melbourne have joined forces to open a new Adelaide sales office located at **Unit 2, 27 College Rd, Kent Town SA 5067, tel (08) 363 4343, fax (08) 363 4366.** □

Due to recent expansion, component distributor **Veltek** has moved its Sydney office to larger premises. According to Veltek's NSW manager Vicki Kulman, "With a rapid growth in sales in recent years...it was necessary to more than double the space available." Veltek's new contact details are: **Level 4, 5 Belmore St, Burwood NSW 2134, tel (02) 745 1400, fax (02) 745 1401.** □



Vicki Kulman of Veltek.

Electronic messaging helps keep profits at home

Australian company Base Information Systems has won a contract to supply ISONET Ltd with an electronic messaging infrastructure.

ISONET is the central office within the Commonwealth government funded Industrial Supplies Office, its role being to promote Australian industry using a database of industry capability to assist purchasers to replace imports and maximise Australian content in contracts for goods and services.

Base will implement an electronic

messaging service for the exchange of information between ISONET and ISO offices in all capital cities as well as regional centres such as Townsville and Alice Springs. When fully installed, the system will link 60 officers at 17 sites around the country, and one site in Wellington, New Zealand.

ISONET's executive director Chris Neil, said "Base was awarded the contract because its fully-integrated messaging system offered immediate efficiency and value for money, while pro-

viding a gateway to further development in data exchange and interrogation." Neil continued "Timely, efficient exchange of information such as contacts and bidders' lists was critical to the organisation's program of support for local suppliers and purchasers. Base's electronic messaging system will be used for our day-to-day communications currently carried out by fax, phone and mail."

The system is expected to be fully installed and operational by April this year. □

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are checked against GSM 11.10 mask, phase/frequency error analysis and burst timing.

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Tokyo meeting agrees on DVD format

A meeting in December of representatives from nine major electronics companies resulted in an agreement on the name and technical specifications of high-density optical discs.

The name for the new format is DVD. Agreement was reached by the nine companies — Toshiba, Matsushita, Sony, Philips, Time Warner, Pioneer, JVC, Hitachi and Mitsubishi Electric — in mid-September on the common format for the discs. The parties will now be discussing a patent licensing program.

DVD technology promises important benefits for consumers, the film and computer industries, and consumer electronics firms. The companies supporting DVD will now propose and promote a wide range of applications for the format, continuing to develop the technology, and working to position DVD optical discs as the ideal digital storage medium.

Specifications have now been finalised for the DVD movie player and the ROM for computer applications, reflecting the recommendations which came from the movie and computer industries. Specifications for music applications will be finalised after hearing recommendations from the music industry. □



Peter Papaioannou, national partner program manager with Cisco Systems Australia congratulates Chris Cheadle, national manager of Network Enable, the network integration arm of Unisys Australia, on his company's winning Cisco Systems' Best Performance — First Year award for the Intercontinental/Japan region. During 1994/95 Network Enable made major Cisco sales to customers including the Defence Plaza, Victoria; the Department of Defence; and Sun Corp, Queensland. □

New fabs within two years

New semiconductor fabrication facilities will be going up in Japan and Germany in the next two years. Toshiba announced in December that it will build a new manufacturing facility for logic ICs and semiconductor memory in Iwate in northern Japan, and AMD will build a microprocessor centre in Dresden, Germany.

Approximately 130 billion yen will be invested in the new Iwate facility in the next three years. Construction of the building will start in April this year, with production planned to begin mid-1997. The plant will employ 500 people.

Toshiba says the new equipment in the facility will be capable of producing ICs up to the 0.25 micron design rule on 8-inch wafers. Monthly production capability is expected to be 30,000 wafers. The new facility will also produce highly integrated system LSIs that unite specialised chips and logic circuitry on a single chip; logic ICs; and memory with a process level equivalent to 64 megabit DRAMs.

A particular feature of the new plant will be its manufacturing process control system, which will allow flexible allo-

cation of production volumes to different products according to demand. Production is planned and supervised for each individual wafer, so different products like logic ICs and memory can be produced on one line at the same time.

The new system will be able to produce diverse products in small lots to meet customers' demand. LSIs can be produced to customer specifications, and single chip ICs integrating circuits and memory.

The German facility, still subject to final approval from the German government, will be funded by AMD to the tune of US\$5 billion in the first five years for construction of the semiconductor wafer facility and establishment of a design centre. It will employ more than 1,400 people. Called "Fab 30", it will be capable of producing up to 6,000 eight-inch wafers per week. The facility will start up on AMD's 0.25 micron process technology and migrate to 0.18 micron later.

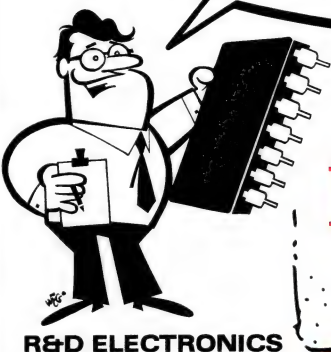
The design centre incorporated in the venture will conduct research and development activities for future microprocessors

and related products. The design team will work with counterparts in California and Texas to bring new microprocessors to market. It is expected to start operations two years after the start of construction in Dresden.

The Chairman and CEO of AMD, W.J. Sanders, said "Fab 30 will be AMD's first wafer manufacturing facility in Europe...[and] Germany is the largest and strongest market [there]. The governments of the Federal Republic of Germany and the state of Saxony will provide substantial financing assistance to AMD through grants and allowances, loan guarantees and loan interest subsidies."

A report by US market research firm VLSI Research on the increasing capacity of the semiconductor industry has analysed announcements of new fabs, upgrades and additions, and states that if the industry maintains its current rate of growth for the next three years, it will be able to support a \$360 billion semiconductor market by 2000. □

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Queensland power nets US gong



The AUSTA Electric Stanwell power station, Rockhampton — international recognition.

The AUSTA (Queensland Electricity Commission) Electric Stanwell power station in Rockhampton, Queensland was awarded Electric Power International magazine's annual Powerplant Award at a ceremony in New York on November 29.

Stanwell was chosen for "pushing the envelope on automatic control and monitoring of a large coal-fired powerplant and revamping the station's corporate culture."

The station is equipped with Siemens' Integrated Control and Monitoring System (ICMS). According to Siemens, part of the station's ICMS success has come from the installation of the Telperm ME control and monitoring system. Telperm ME allows the 4 x 350 megawatt coal-fired plant to be run by only two people — a skilled production technician and a plant monitor. The plant monitoring station can also be left unsupervised for up to two hours. The permanent staffing level at the plant is claimed by the magazine to be one of the lowest in the world for a power station of this type and capacity. □

France Telecom shafted by Poles

France Telecom has issued a notification of arbitration to the Republic of Poland and the state-owned telecommunications operator Telekomunikacja Polska.

France Telecom is quarter owner of PTK Centertel, a Polish telecommunications company, with Telekomunikacja Polska owning a controlling 51%. France Telecom is commencing litigation as it claims the Polish government has denied PTK Centertel the right to obtain a GSM licence, breaking clear commitments made in 1991. France Telecom is basing its case on the Franco-Polish agreement on mutual encouragement and protection of investments signed in Paris in 1989.

The company is claiming \$500 million for the capital investment it has put into building and operating PTK Centertel's NMT analogue network, and the loss of income from the GSM business Centertel intended developing. □

Fluke multimeter recall

Philips Scientific and Industrial is advising owners of certain models of Fluke digital multimeters to return them for a safety modification. The models concerned were manufactured after July 1994, model numbers 21, 23, 70, 73, 75, and 77, with serial numbers in the range of 60990000 to 63752000.

Philips says a malfunction may arise in the affected units when used to measure 400Vdc or greater. The meter may go into a lock-up state and indicate a

reading of (or near) zero.

The safety modification involves the installation of a special capacitor and includes free calibration for those affected meters returned for modification.

Multimeters that have the modification will be marked with the letter 'R' or a blurry number 9 near the serial number. For enquiries ring **Paul Tamone on (02) 888 0491** and quote *Australian Electronics Engineering*. □

Cable telecomms to explode in next 5 years

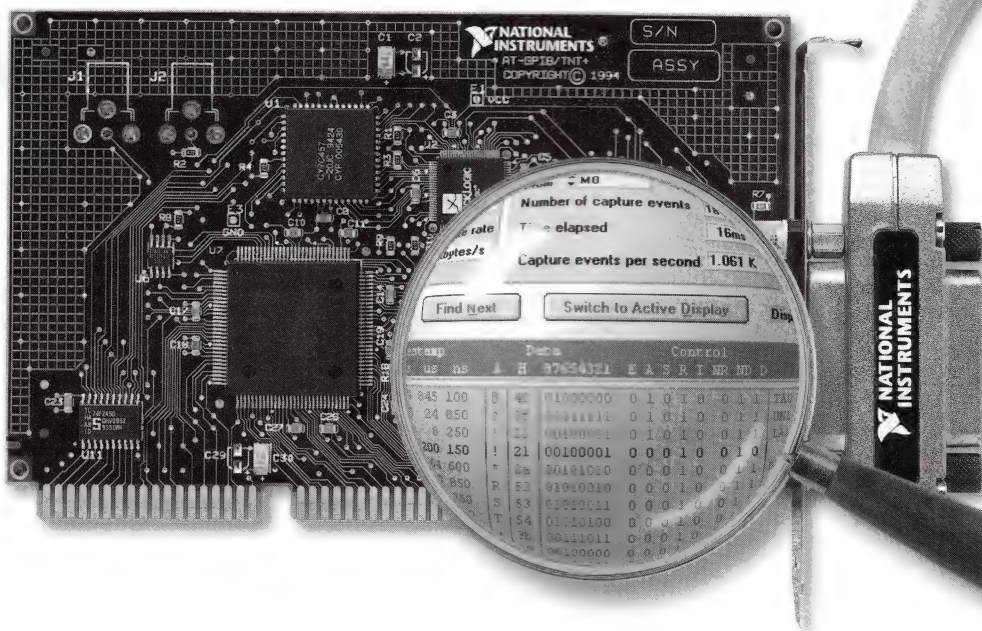
A recent study by market research company Frost & Sullivan has predicted that overall revenues for cable telecommunications in Europe will reach US\$48.49 billion in 2001. The number of cable telecomms subscribers in Europe is expected to reach 19.73 million in the same year.

According to the study, the market development of cable telecomms in Europe is subject to three principal drivers: the

expansion of US regional operating companies and media groups into telecomms; the liberalisation of the telecomms infrastructure in Europe from 1998, a process which has already started in some countries; and the liberalisation of services, especially voice telephony.

The study states that currently the UK has the dominant market position, while Germany has the potential to be the largest market. □

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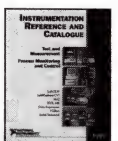


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Kalamazoo buys Arlec

In a surprise move late last year, business systems specialist Kalamazoo Holdings acquired the businesses of the Arlec Group for a reported \$50.9 million.

The Melbourne-based Arlec group comprises a Consumer Products Division responsible for marketing a range of consumer electrical and electronic products, a Technical Products Division which distributes both active and passive electronic components including brands such as NEC and Philips, and Arlec Electronic Products Hong Kong which includes a large manufacturing facility.

Before the buy-out the company was privately owned and run by its five directors. Kalamazoo has stated that the five will continue in their current management roles and all employees at Arlec will be retained.

Joe Telfer, one of Arlec's directors, said the company had gone about as far as it could as a privately owned and managed business and had actively sought

offers of interest. The move to put Arlec up for sale was prompted in part by the decision of George Soanes, Arlec's chairman, to scale down his active involvement in the company.

Arlec has been in business in Australia since 1945 and last year posted sales of \$89.2 million. Kalamazoo's managing director Paul Favretto said that "Arlec represents an excellent platform from which Kalamazoo can develop a major internationally-based operating division focused on the design, manufacture and sourcing of a broad range of electronic, electrical and hardware products for distribution to the Australian and international consumer, trade and original equipment markets."

Favretto went on to say "The Arlec acquisition is the culmination of what has been a very demanding and active first year

for the new Kalamazoo management team. In this period we have successfully acquired Arlec and the 25% minority interest in Unistrut, mounted two public company bids, sold the Windows division, proposed a merger with Avatar, and built a totally new head-office team."

John Cotter, Arlec's director of finance, said that it had been "business as usual" since the acquisition last November. He said Arlec's staff had reacted well to the news and felt the ownership change would benefit Arlec in the long run. □



Arlec Director Joe Telfer

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Adilam gets it right

Melbourne-based component distributor Adilam Electronics said its broad customer base, reliable overseas supplies, and employees who aim to "do it right first time" were the reasons they won the 1995 Wholesale, Distribution and Allied Industries category of the Victorian Business Awards at a ceremony on 23 November.

Managing Director Keith Anderson said careful monitoring and control over the financial aspects of the company, in particular the cash flow and debtor and creditor payments, as well as positive support from their financiers and bank, had also been significant factors in their success.

Adilam's sales have increased by an average of 30% during the past three years, and 20 new positions have been created. The 12 year old company recently expanded its operations into Queensland and New Zealand. □



Robert Gottlieb of BRW, guest speaker at the Victorian Business Awards, with Adilam directors Margaret and Keith Anderson.

Traffic watcher

A high-tech road safety device developed jointly by Telstra, the Roads and Traffic Authority of NSW and CSIRO was awarded the prestigious Rolls Royce/Qantas award for Engineering Excellence in a ceremony late last year.

Safe-T-Cam is a unique digital imaging system that automatically detects and classifies moving vehicles, identifying large vehicles and reading their number plates. The unit can transmit information on heavy vehicles to a central management centre where it is checked against other vehicle database information.

Safe-T-Cam was chosen for the award because it has driven the world development of cameras and vision devices to new levels of sophistication. The system is currently being used by the RTA at four sites in NSW with a further 16 sites under construction. The system operates 24 hours a day in all but extreme weather conditions and has an accuracy record better than any other known system. □

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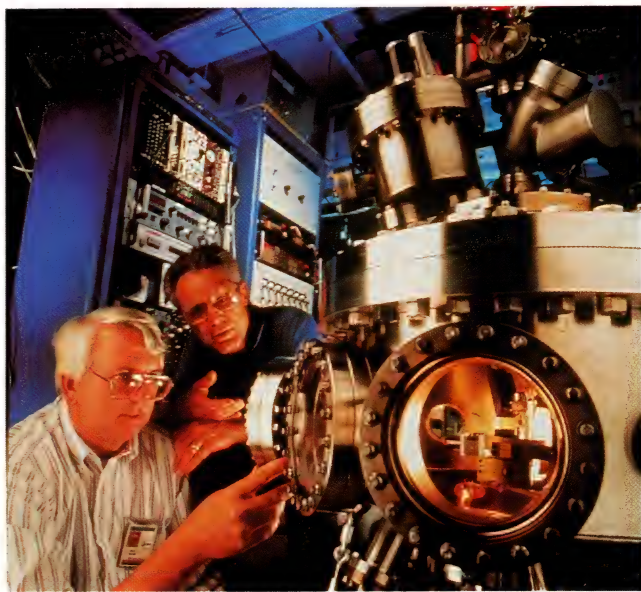
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Scientists Jack Rowe and Ed Chaban of AT&T Bell Laboratories have developed a powerful photoelectron microscope that uses ultraviolet light to detect chemical and electronic information of molecular features 10 times smaller than the finest details on the most sophisticated chip circuits. The microscope transmits light invisible to the eye, generated from a rare-gas discharge lamp via a hollow glass tube to scan samples in a vacuum chamber. The electronic and chemical readings about 500 angstroms in size, are digitised and displayed on a workstation. It is useful for analysing impurities in semiconductor materials and thin oxide layers used in the manufacture of electronic devices such as high-speed switches or lasers for communication equipment. □

NexGen and AMD to merge

Advanced Micro Devices (AMD) and NexGen Inc. have announced their signing of a definitive agreement under which AMD will acquire NexGen in an all-stock transaction.

AMD plans to operate NexGen as a wholly-owned subsidiary out of its current location in California. NexGen will be primarily involved in developing high-performance Windows-compatible microprocessors in the AMD K86 Superscalar series.

W.J. Sanders, chairman and chief executive officer of AMD, said "The union of NexGen with AMD catapults us into contention for leadership in the market for fifth, sixth and future generations of Microsoft Windows-compatible microprocessors...and gives AMD the ability to...close the gap with Intel on future microprocessor generations." □

Krone signs \$62m FTA

Krone signed a Fixed Term Agreement with the Federal government late last year, agreeing to investment strategies worth \$62 million over four years.

The company will be developing its R&D program in telecomms, power and control equipment and information systems; expanding its export program and staff training program; and investing in Japan and in its manufacturing facilities in Wyong.

Marketing director of Krone Australia, Bob Fitzgerald, said "Krone Australia's

investment in local R&D has led to a number of world firsts, the most recent being the development of 'Terminator', a revolutionary industrial cabling product. Terminator allows cabling termination four times faster than existing technology, and provides a connection which is maintenance-free."

While only launched in June this year, interest in Terminator has already come from South Africa, Europe, and North and South America. The product is expected to account for a major share of the worldwide \$3 billion industrial cabling market.

Another current focus for the company is research into the development of cabling system products for the pay TV market, being carried out by the Communications division.

Craig Jones, finance director at Krone said "With the growth in global demand for our products, we've had to increase our manufacturing capacity. We're currently extending our plant and will be increasing our workforce by 50% over the next two years to meet the demand." □

AT&T \$20m QLD plant

AT&T opened a high performance communications products factory in Queensland in November last year.

The \$20 million manufacturing plant in the Brisbane suburb of Pinkenba was officially opened by Queensland Premier Wayne Goss, with Federal Minister for Communications and the Arts, Michael Lee.

The plant is producing cable for AT&T's SYSTIMAX structured cabling system, and is the only facility doing so in the Asia Pacific region. SYSTIMAX is experiencing high sales growth worldwide. The cabling system is used in private communications networks to transport voice, data, image and sensor control signals within and between buildings.

85% of the factory's output is being exported to the Asia Pacific region. □

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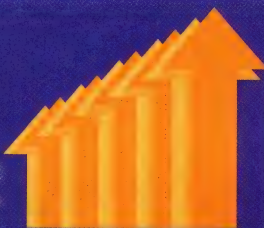
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AUSTRALIA

Interactive Multimedia '96, February 26 & 27, Landmark Hotel, Sydney. Contact: IIR Conferences, tel (02) 9954 5844, fax (02) 9959 46884. □

Mobile Data and Computing, March 4-5, The Boulevard Hotel, Sydney. Contact: AIC Conferences, tel (02) 210 5777, fax (02) 221 7773. □

PC 96, 28th Personal Computer Show, March 5-8, Darling Harbour, Sydney. Contact: Australian Exhibition Services, tel (03) 9867 4500, fax (03) 9867 7981. □

The 1996 Switching Forum, March 13-14, Tattersalls Club, Sydney. Contact: AIC Conferences, tel (02) 210 5777, fax (02) 221 7773. □

Quality - the Catalyst for Engineering Excellence seminar, March 17, World Congress Centre, Melbourne. Contact: Amanda Dawson, Australian Quality Council, tel (02) 9901 9910. □

Mobiles '96, March 18-19, Wentworth Hotel, Sydney. Contact: IIR Conferences, tel (02) 9954 5844, fax (02) 9959 4684. □

Course in application of system EMI/EMC methodologies, March 21-22, Melbourne, **March 25-26**, Adelaide, **March 28-29**, Sydney. Contact: AEDC, tel (03) 9302 1422 or 1800 339 601, fax (03) 9302 1201. □

Cable & Telephony, March 25-26, the Gazebo Hotel, Sydney. Contact: AIC Conferences, tel (02) 210 5777, fax (02) 221 7773. □

Spaceworks '96, March 25-29, 1996, Canberra. Contact: CSIRO, Office of Space Science and Applications, GPO Box 3023, Canberra ACT 2601, tel (06) 216 7200, fax (06) 216 7222. □

Australasian Science Fair, March 26-27, 1996, Sydney. Contact: Dr Ian Humphery-Smith, Dept of Microbiology, University of Sydney, NSW 2007, fax (02) 351 4571. □

OVERSEAS

Soft Magnetic Materials 96, February 26-28, San Francisco, USA. Contact: Jenifer Winch, Gorham/Intertech Consulting, 411 US Route One, Portland, Maine 04105, USA, tel 1207 781 9800, fax 1207 781 2150. □

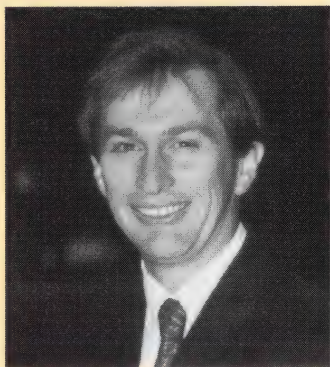
IPC Printed Circuits Expo, March 3-7, San Jose Convention Centre, California. Contact: Kim Behr, IPC, 2215 Sanders Rd Northbrook Illinois USA, tel +1 708 509 9700, fax +1708 509 9798. □

India Telecommunications '96, April 1-3, Taj Palace Intercontinental Hotel, New Delhi. Contact: IIR Ltd, Level 20, Siu On Centre, 188 Lockhart Rd, Wanchai, Hong Kong, tel +852 2586 1777, fax +852 2507 5666. □

5th International Conference and Exhibition on Multichip Modules, April 17-19, Marriott Tech Centre, Denver Colorado, USA. Contact: International Electronic Packaging Society, 5200 Willson Rd, Suite 215, Edina, MN 55425, USA, tel 612 922 1988, fax 612 926 1819. □

24th International Exhibition of Inventions, New Techniques and Products of Geneva, April 19-28, Palexpo, Geneva. Contact: Salon des Inventions, 8 rue du 31 Decembre, CH - 1207 Geneva, tel +41 22 736 59 49, fax +41 22 786 00 96. □

ON THE MOVE



Glenn Cooper

Interleaf has appointed **Glenn Cooper** as a senior consultant. Glenn will help customers integrate the company's products with applications already in use to streamline business processes. Glenn has eight years experience with Wang in R&D and professional services. □

Malcolm Mulcarel and **Tien Nguyen** recently joined RFI Industries' EMI/EMC test lab. Malcolm has joined as senior test engineer, having held key elec-

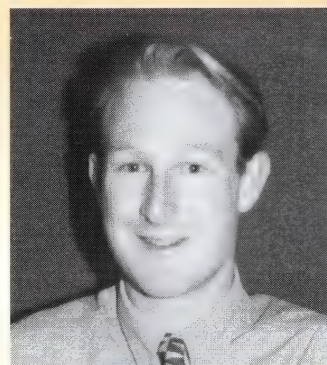
tronics engineering positions in government and commercial areas. Tien is a graduate electrical and electronics engineer. □

Bryan Sue San has been appointed CEO of Stanilite's newly formed telecommunications division. Bryan was previously General Manager of JNA Telecommunications and has over 20 years' experience in the banking, finance, computer and telecommunications industries. □

Stuart Althaus and **Peter Wright** have been appointed to Consultel's Board of Directors. Stuart joined Consultel three years ago from the Computer Power Group where he was a senior consultant. He is manager of Consultel's ACT branch, responsible for the company's business with Federal government departments. Peter joined Consultel five years ago from OTC where he was in engineering operations and R&D. He is manager of Consultel's NSW branch which he has developed into one of the major offices of the group. □

Tracey Arentz has been appointed Sales Representative in the Sydney

office of IMP Engineering. Tracey has extensive experience in the industry, coming from Morris Productions where she was in a sales position for nine years. □



Anthony Pitt

Amtext Electronics has appointed **Anthony Pitt** as internal sales engineer in its Displays and Systems division. Anthony will be looking after Optrex LCDs, Lucas Deeco displays, Planar EL displays, single board computers, etc. He joins the company from Balmoral Technologies and is currently finishing an electrical technology diploma at TAFE. □

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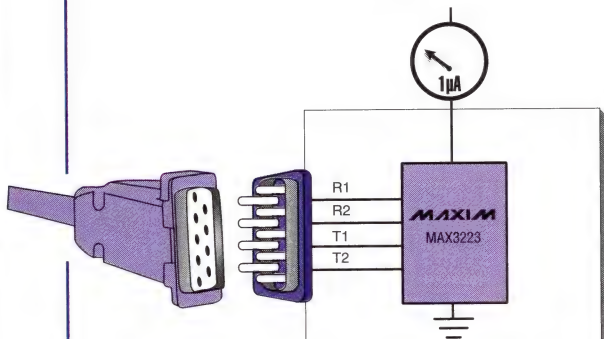
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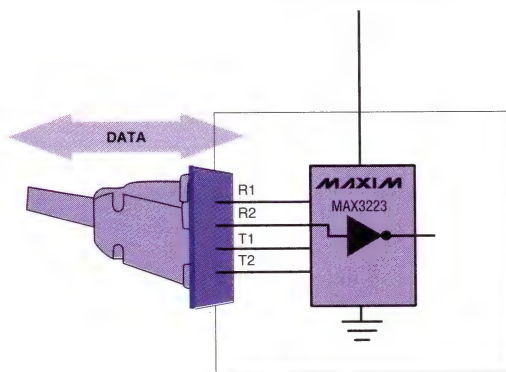
V_{CC} = 3.0V to 5.5V



Automatically Reduces Supply Current to 1 μ A

Serial Cable Connected

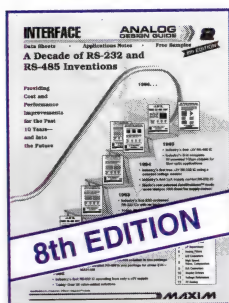
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MAX3223	+3.0 to +5.5	4 x 0.1	1	120	AutoShutdown
MAX3232	+3.0 to +5.5	4 x 0.1	300	120	Industry-Standard MAX232 Pinout



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Innovate Australia — an industry view

On December 6, 1995 Paul Keating delivered the government's much-heralded innovation statement under the title 'Innovate Australia'. AEEMA, in its capacity as the peak industry association representing the Australian electrical and electronic industries, was significantly involved in the development of the statement and was successful in having a number of its recommendations adopted. *Alex Gosman* of AEEMA looks at the implications of the statement for the Australian electronics industry.

The Minister for Industry, Science and Technology, Peter Cook, foreshadowed the delivery of a government innovation statement in late 1994. At a meeting of the telecommunications export development group of the Australian Electrical and Electronics Manufacturers' Association (AEEMA) in December 1994 Senator Cook highlighted the importance of innovation in fuelling productivity growth and the creation of new industries and new jobs. He noted that in high-tech industries such as electronics, innovation was a critical competitive factor.

The recognition by the government of the need for increased encouragement of innovation reflected the view that in an increasingly globalised and competitive business environment, Australian firms must be world-competitive to win and keep new markets. Whilst a number of major measures has been introduced by the government to encourage innovation (such as the 150% tax concession for R&D), increasing international competition has made it necessary for the government to take action to further strengthen Australia's innovation capabilities, both at the individual company level and in supporting institutions.

Innovation is the key competitive weapon for the electronics industry. For example, annual expenditure on research and development within the Australian telecommunications industry exceeds

\$300 million. This is equivalent to over 6% of company turnover, which

in several round table discussions with Senator Cook to canvass various ideas and proposals. In addition, the Association maintained close contact with the Innovation Taskforce within the Department of Industry, Science and Technology (DIST) responsible for much of the preparation of the statement.

Innovate Australia

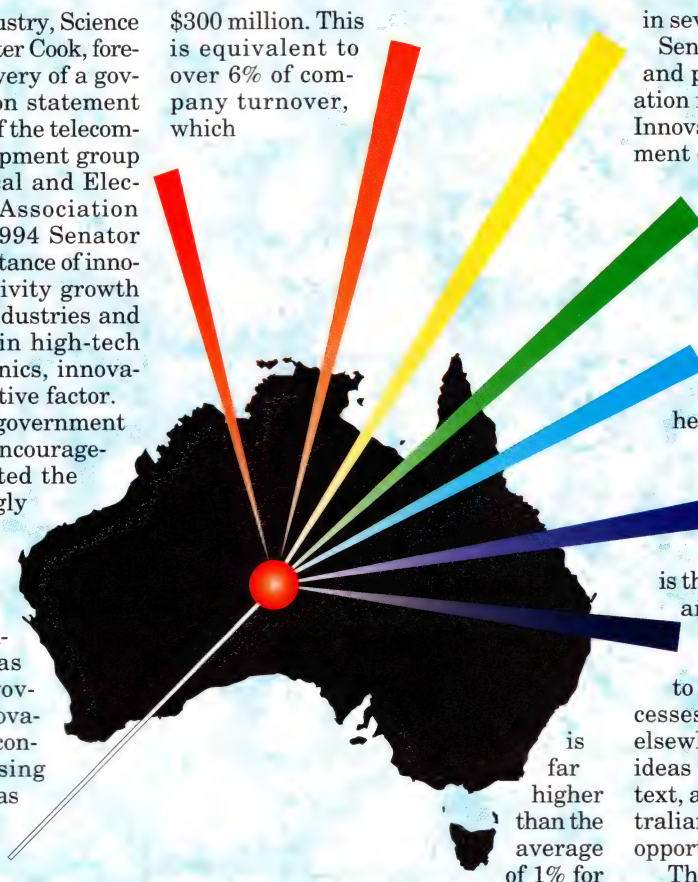
In releasing the statement in December, the Prime Minister commented "Innovation lies at the heart of productivity growth. It is not the skills of the work force or management or the capital they have to use, but how these are used in evermore productive combinations, which is the central driver of economic growth and rising living standards." The theme of the statement was to introduce policies that "continue to do what works, by building on successes, by understanding what works elsewhere, by trialling innovative new ideas generated for the Australian context, and by upgrading the skills of Australians to take advantage of emerging opportunities."

The Prime Minister went on to say that the Government's strategy is "to build on the existing successes in policies and programs, to adopt measures to strengthen the capabilities of elements of the system, to enhance the linkages between elements and to create an environment conducive to innovative activities."

Australian manufacturing in general. Both Alcatel Australia and Ericsson Australia are ranked in the top 10 Australian companies in expenditure on R&D.

AEEMA and its various constituent organisations, such as the Australian Telecommunications Industry Association (ATIA), were involved in early 1995

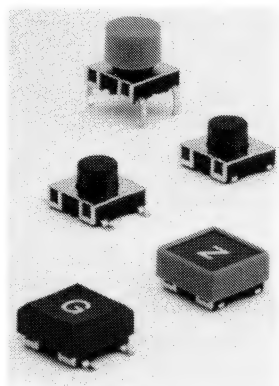
is far higher than the average of 1% for



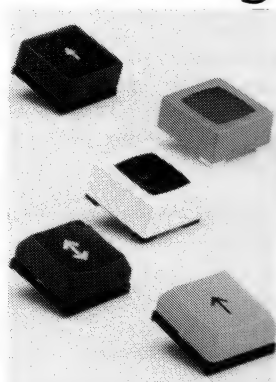
S SCHURTER

IT'S YOUR TURN TO SWITCH US ON

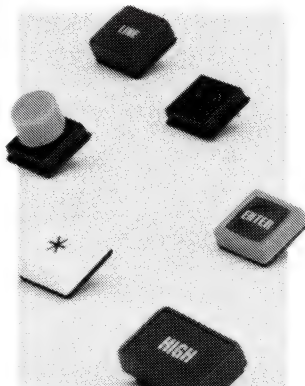
the modular construction of Schurter switches and push button switches enable a high level of design flexibility.



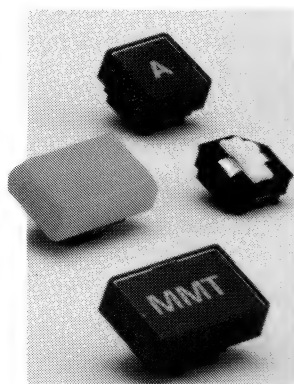
Modular keytop switches, short travel SMS/PMS/PMK



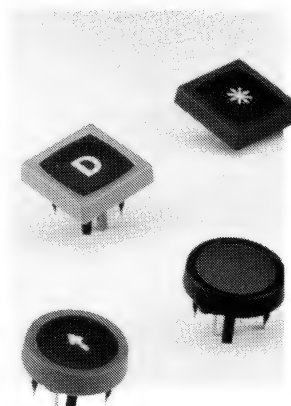
Modular PCB keytop switches MTG/MCS/MTP



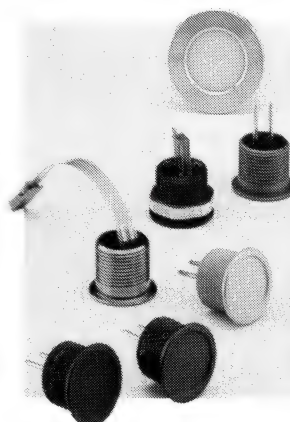
Modular PCB keytop switches



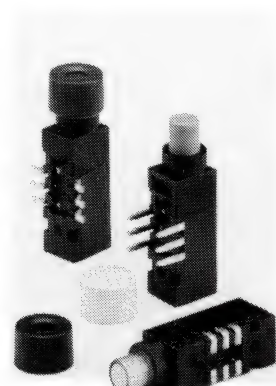
Medium travel keytop switches MMT



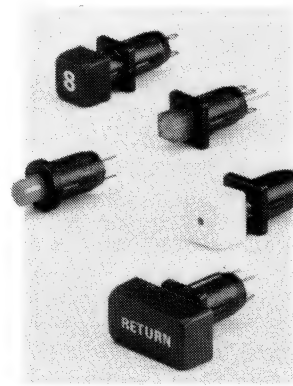
Single membrane switches MCS 18



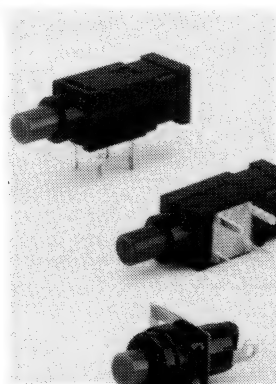
Single key Piezo switch



Horizontal switches and pushbutton switches HDT/HDS



Miniature switches and pushbutton switches LDS/LDT



Miniature pushbutton switches SDK/PDK

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Innovate Australia contains a \$495 million package of measures, including some \$410 million of new expenditure, over four years. The major elements of the package are in five areas.

Generating ideas

Initiatives to spark creativity include:

- funding for seven visionary science projects to boost the science infrastructure;
- continuation, but with fine tuning, of the 150% R&D tax concession scheme;
- renewal of the \$40 million per year competitive grants scheme for industry research and development;
- the funding of five new Cooperative Research Centres.

Commercialising and using new ideas

Initiatives to help get new ideas to market include:

- allowing banks to provide equity capital to clients wishing to fund business expansion, opening an important source of growth capital;
- the introduction of a number of investor/industry investment match-making schemes;
- funding for additional Technology Support Centres.

Linking Australia to the world

Projects announced in the statement to enhance Australia's links with the rest of the world include:

- expansion of support for international science and technology links and cooperation;
- Austrade encouraging more active pursuit of exports by government departments.

New ideas in business and the workplace

Aids to help companies improve their business practices include:

- the establishment of a Leading Edge Customers program to highlight the benefits of close, long term relationships with suppliers;
- support for improved management practices and a Benchmarking Information Service.

Accelerating ideas: Information superhighway

New programs to promote the take-up of information services by Australian businesses include:

- a Superhighway Ready Scheme to demonstrate how businesses can use network information services to re-engineer and go global;
- extension of the Computer Bounty scheme;
- a new Senior Partner program for global IT&T companies when they "graduate" under the Partnership for Development program;
- a major study of Australia's IT&T competitiveness;
- support for broadband communications between super computers.

Implications for the Australian electronics industry

Because of the importance of innovation, technological change, and shortening product life cycle times, the Australian electronics industry has a vital interest in the content of *Innovate Australia*. Overall, the Association considers the statement provides a welcome degree of support for innovation within the industry. The fact that the focus of many of the measures is on the electronics industry reflects a welcomed awareness of the importance of the industry to Australia's future prosperity.

The most welcome initiative is the continuation of the Computer Bounty scheme. The scheme was scheduled to conclude at the end of December 1995 and its future was examined as part of the Industry Commission inquiry into the computer hardware, software and related services industry. The Commission recommended against its continuation.

AEEMA strongly opposed this recommendation, as the bounty has provided direct support for investment, domestic production, design and research capabilities within the telecommunications industry. It has complemented Australia's competitiveness in telecommunications technologies. A survey of ATIA members confirmed overwhelming support for the extension of the scheme, based on the positive effect it has had on company performance in supporting increased levels of research and development, investment, manufacturing and exports. The Association lobbied heavily for the continuation of the bounty.

Its continuation, therefore, (at a rate of 5% from January 1, 1997 and with the withdrawal of the eligibility to claim for R&D) was very happy news. From the government perspective, the foreshadowed annual expenditure on the bounty of \$50 million is more than recouped in increased levels of value-adding, etc. The decision to continue the bounty was also a testament to the support for the electronics industry of Senator Cook, who had to battle strong opposition to the extension of the bounty from the treasury and finance departments.

Whilst the withdrawal of the entitlement to claim for R&D will have some adverse implications (these vary from company to company), it was a compromise necessary to ensure the continuation of the bounty.

Also welcome is the Government's commitment to the retention of the 150% R&D tax concession. The refinements to the concession, which include restrictions on syndication arrangements, should have the effect of more tightly focusing

the incentive on genuine new research.

The Association also lobbied heavily for improvements to the operations of the Tariff Concession Scheme by which companies can gain duty free entry for products on the basis that equivalent goods are not manufactured in Australia. If equivalent goods are manufactured locally, the concession could still apply if the duty-free entry of such products did not have a detrimental effect on local production. In practice this latter aspect, the market test, has proved difficult to administer. It has also, in some instances, been subject to rorts, which has had the effect of reducing the levels of stated assistance provided to industry and reducing investment. The Government accepted the arguments of AEEMA for a tightening of the tariff concession arrangements and the dropping of the market test aspect.

Many of the measures within the statement are very much directed at assisting small to medium enterprises (SMEs) develop new products and bring them to market, and overcoming funding constraints that have often held back product development. The ability of banks to take equity positions should increase the depth of the finance sector, while "match-making" programs designed to encourage closer links between investors and companies should prove productive. The initiatives announced by the government in *Innovate Australia* will further improve the efficiency and effectiveness with which funding is provided by Australia's financial sector. □

The author is the chief executive officer of the Australian Electrical and Electronics Manufacturers' Association (AEEMA). For further information or advice on the measures directed at the company level, contact one of the AusIndustry offices located in most main cities, or the AusIndustry central office in Canberra on (06) 27 6100. Alternatively, contact AEEMA on (06) 247 4655.



AUSTRALIAN Electronics ENGINEERING

SPECIAL FEATURE

Test & Measurement



Austest's new EMI site — space for the
largest equipment Page 32

Test & Measurement

This month's product survey presents the latest in test & measurement products. For more information on any item, complete the enquiry card on pages 26 & 66 of this issue.

Recording digital oscilloscope

The Hioki 8852 HiCORDER from Nilsen Technologies can accommodate up to 4 channels with a bandwidth of 100MHz, 3 channels with 8 logic channels and other combinations such as 2 channels plus 16 logic channels. Sampling rate is 200MS/sec maximum and 100MS/sec for four analogue channels.

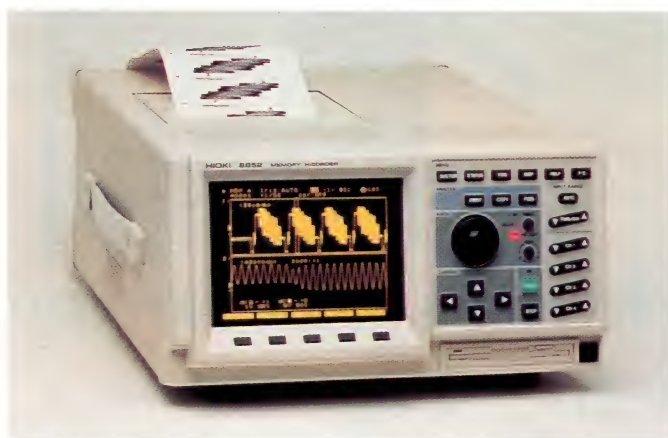
In addition to its many industrial applications, the instrument is suited to video signal monitoring, disk data capture and magnetic card signal monitoring through its triggering capabilities. These include TV (number of fields, specification of number of lines for NTSC/PAL) as well as other modes such as glitch, level and level with time-out, window, and event (with a specified number of trigger crossings).

As a memory recorder, the 4 Megaword memory allows data storage to more than 138 hours at five seconds per recording division. Maximum recording resolution is 200ns/division.

Calculation functions include FFT in the range of 4Hz to 50MHz, with analysis modes including linear and power spectrums as well as histograms. Parameter computations such as maxima, minima, RMS, frequency, and area between cursors are also provided.

In addition to the standard floppy drive in the instruments, the SCSI interface allows connection of a hard disk. [910](1270)

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Rugged DMMs

The Pantec 2700/2800 series of digital multimeters, available from Obiat, is a family of four rugged, hand-held instruments featuring large, easy-to-read displays with high-resolution bargraph and many functions found only on much higher cost units. These include high basic accuracy and facilities such as frequency and capacitance measurement, memory store and recall and relative measurements, and fused current ranges, in addition to the usual DMM functions.

All units allow the use of a wide variety of plug-in adapters and probes to measure temperature, rotational speed, EHT, non-contact current, etc. Two models, the PAN 2720RMS and PAN 2820RMS, are true rms measurement instruments.

Pantec's 2700/2800 series are designed to conform to IEC 348 and UL 1244 Class II safety specifications. The 2800 series is also water resistant to IP64. [1270](1826)

ENTER 0401 ON CARD

High speed data collection

Available from Marconi Instruments is i-Base, a real-time test monitoring system that provides, through advanced database and graphics technology, comprehensive data collection, analysis and presentation.

Available in single or multi-user options, i-Base is designed for electronics test and rework areas, inspection departments and for quality audits. Reports on faults and their causes allow corrective action to be taken quickly and errors to be reduced.

i-Base builds and maintains a picture of manufacturing performance by collecting test results. Performing data analysis on those results, it reveals major faults, trends, and operational yield statistics, by end-of-shift or in seconds, in real-time. When operating on repair-centred data, i-Base provides an understanding of failure causes, providing key information about potential problems and weak links in product manufacture, material and design. [384](5396)

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Along with other Protel products, now the entire design process, from capturing the design concept in a schematic through to generating manufacture files can be carried out in the Protel EDA/Client design environment.

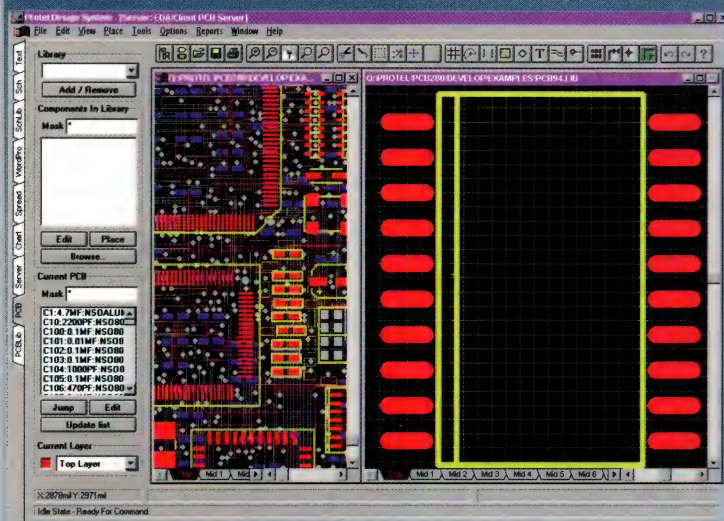
PCB 3 Features:

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- PCB Editor to create, edit and verify designs, create component footprints.
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Customise with Macros

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Advanced

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PCB3



Enhanced Speed

- A new spatial data structure provides a leap forward in graphical operational performance for panning, redrawing, zooming and selecting.

Component Browser Panel

- Add and remove libraries, place component footprints and browse through components placed in the workspace.

Routing Enhancements

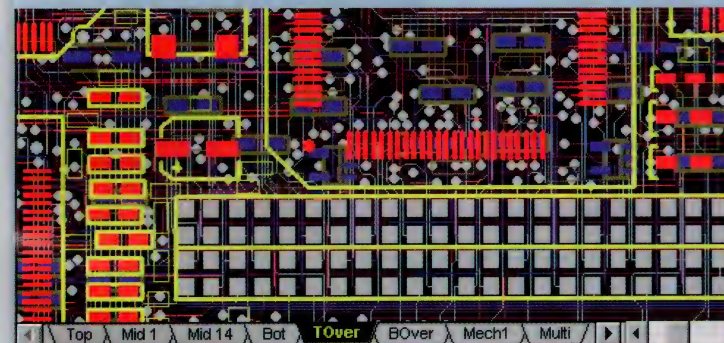
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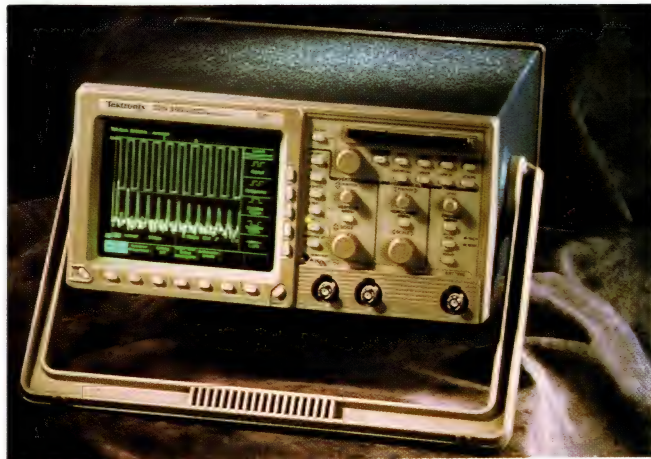
- Designed to present information in an easy-to-read style.



Layer tabs show which layers are active and which is the current layer.

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400MHz digital oscilloscopes

Tektronix has announced three additions to its TDS300 series: 100MHz TDS340, 200MHz TDS360 and 400 MHz TDS380.

The TDS300 digital scopes, available through Emona Instruments, are basic troubleshooting instruments targeted primarily for the education, design, service and repair markets. With the TDS340, 360 and 380 models, customers can now obtain the benefits of digital scopes at a price nearer analog scopes. With the digital capability of the TDS300 series, users can store set-ups and waveforms and perform 21 different automatic measurements.

TDS300 digital scopes include a Fast Fourier Transform (FFT) capability, useful for analysing harmonic content of signals in power supplies, noise in mixed digital/analog systems, line current harmonics and vibration systems.

All three scopes feature Tektronix' patented Digital Real-Time (DRT) oversampling technology, which is claimed to dramatically reduce aliasing and enable single-shot waveform capture at the instrument's full bandwidth. The TDS340's two channels digitise at a rate of 500 megasamples per second, the TDS360 at a rate of 1 gigasample per second and the TDS380 at a rate of 2 gigasamples per second.

For design and repair users, the 3 1/2 inch DOS compatible floppy disk drive built into the TDS360 and 380 models is useful for storing reference waveforms, downloading waveforms and setups and importing and exporting waveform values into application programs. [1270](2)

ENTER 0403 ON CARD

Programmable digital oscilloscope

Nilson Technologies has available the Metrix OX2000 150MHz programmable (SCPI) digital oscilloscope with LabView/LabWindows/CVI drivers capability.

The four-channel unit has a bandwidth of 150MHz, a single-shot sampling rate of 200MS/s, and up to 50GS/s for repetitive waveforms. The instrument has internal memory of 40KB allowing the storage of four waveforms of 10,000 points

each. A built-in PCMCIA capability extends the storage capacity by 1MB per card.

The OX2000 is fully programmable with Standard Commands for Programmable Instruments (SCPI). Standard ports are RS232, IEEE488.2 and Centronics, enabling screen output to be sent to a printer, plotter or computer. [1270](910)

Economy network analysers

Wiltron has available the 54000A series scalar measurement system which offers low-cost RF models to 0.1 and 3.0GHz. Microwave models are available to 8.6 and 20GHz. The analysers perform traditional transmission and return loss (SWR) measurements for manufacturing applications.

The 54000A series offers low harmonic source, linearised YIG tuning for stable sweep, 50Ω and 75Ω measurement systems, and an MTBF of 10,000 hours. [2470](5173)

ENTER 0405 ON CARD



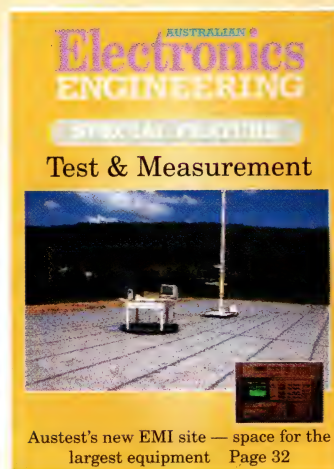
ON THIS MONTH'S FEATURE COVER

Austest Laboratories has recently achieved NATA accreditation for electromagnetic interference testing of information technology equipment to AS/NZS 3548 (European standard CISPR22/EN55022).

Austest is the only test house in Australia capable of performing electrical safety, EMI and interworking standards testing in-house, suitable for Australian and overseas markets.

The EMI site at Yarramalong (near Wyong on the NSW central coast) is registered for testing to both the 1992 and 1995 versions of AS/NZS 3548. The 1995 version precludes class A three metre testing, with testing required at not less than ten metres. Austest's site easily allows for testing at ten metres in full compliance with this new standard, with all site ambients below the class A ten metre limits.

The current lead time for EMI testing is less than one week from submission of item to report, with help available should your product fail to comply. [2440](11262)



Austest's new EMI site — space for the largest equipment Page 32

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Field strength meters

Nilsen Technologies has released three models of METRIX field strength meters. The VX6020 is suitable for all TV, FM, and satellite bands, and covers the field strength range 30dB μ V to 130 dB μ V.

The VX360 is used for analysis of satellite dish signals and has a range of 40 to 90dB μ V and 950 to 2050MHz.

The VX320 measures signal strength on TV and FM bands to adjust off-air antennas or determine signal strength at the cable. It covers the field strength range from 40 to 100dB μ V and frequency range of 45 to 862MHz.

The instruments conform to IEC1010 international safety standards. [2470](910)

ENTER 0406 ON CARD

Ultra-pure RC oscillator

Warburton Franki has introduced the Krohn Hite model 4402B, an ultra-pure sinewave, stable-amplitude oscillator designed to meet the needs of today's high precision 16 to 18-bit A/D testing, and audio test measurements.

Covering the frequency range from 1Hz to 110kHz with precision 3-digit frequency tuning, the 4402B produces a virtually "distortion free" (typically 0.0002%) sinewave, with an exceptionally flat response of 0.02dB, eliminating the need to constantly monitor voltage levels during frequency response testing.

The 4402B provides a 7Vrms sinewave balanced output (14Vrms end to end) 3.5Vrms (7Vrms end to end) into 50 Ω , and has no loss in performance when loaded with a linear 50 Ω load. A 3-position, push-button attenuator calibrated in 20dB steps, along with a 30dB vernier provides a total dynamic range of 90dB.

Additional fixed 7Vrms inverted (180°) and quadrature (90°) outputs, with 600 Ω source impedance, are also provided. [2470](254)

ENTER 0407 ON CARD



Advanced network tester



Available from Wandel & Goltermann is the ANT-20 advanced network tester, which can be fitted with SDH, PDH, SONET and ATM functions, simultaneously if necessary, and is ready for TMN.

Operation follows the same principle as the application-oriented function configuration—lists of parameters are replaced by practical, graphics-supported applications. This is made possible through the use of a built-in PC with Windows user interface and a large number of stored settings, from which the most suitable can quickly be selected using a sort function. [2470](72)

ENTER 0408 ON CARD

Comb generator and calibration source

Dynamic Sciences offers the DSI IG-1800 solid-state RF comb generator, covering the frequency range of 100MHz to 18GHz. This comb generator provides a calibration source for RF measurement systems and receivers. The instrument has the stability of a temperature-stabilised crystal oscillator, a coherent comb line spacing of 100MHz, an output levelling function and is suitable for laboratory or field application. All controls can be remotely operated by the IEEE-488 bus, allowing control over frequency, levelling and signal amplitude.

The CG-1800 features uncomplicated front panel indicators for repetition rate and amplitude. The impulse generator is supplied calibrated in dB μ V (referenced to 50 Ω) with a maximum output of 70dB μ V and an 81dB attenuator with 1dB steps. [2470](13089)

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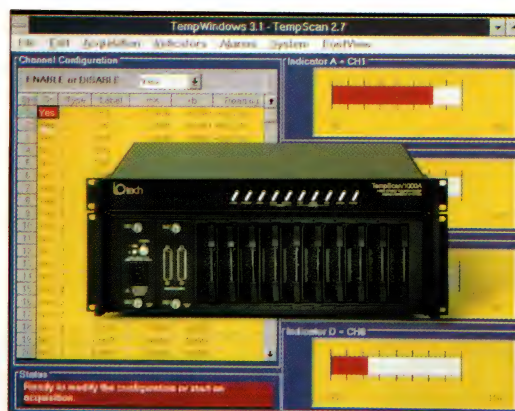
High-speed temperature instrument

Iotech, represented by Scientific Devices, has announced a new series of multichannel temperature measurement products. Included in the series are the TempScan/1000A measurement instrument, the Exp/11A 10-slot expansion chassis and TempWindows 3.1 Software.

The TempScan/1000A is a 32 channel rack-mountable instrument that provides speed, expansion, and economy in a single instrument. It offers features such as relative time stamping of data files; pre and post trigger scanning rates, and optimised set up and acquisition software for stand-alone operation.

The basic unit accommodates a 32-channel thermocouple scanning module, 16-channel RTD scanning module or 32-channel voltage scanning module. Its channel capacity can be expanded with the 10-slot Exp/11A expansion chassis, which accommodates additional scanning modules. The TempScan/1000A can accommodate up to 992 channels when equipped with three fully loaded Exp/11A chassis.

The TempScan/1000A provides linearised and compensated thermocouple readings of 960 channels, an important specification in applications that require monitoring of tens or hundreds of channels. This reading rate is claimed to enable the TempScan/1000A to detect a temperature and react to it as much as one-hundred times quicker than competing alternatives. Furthermore, the unit ensures measurement integrity via its 16-bit A/D converter, which samples and averages multiple readings, enabling it to reject noise resulting from ac line pick-up. [2470](103)



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<p>STANDARD PACKAGES</p> <p>SOT-143 TO-92 SOT-223 SO-8/SO-14 TO-220 TO-247</p>	<p>PERFORMANCE: (conditions vary according to package/series)</p> <table border="0" style="width: 100%;"> <tr> <td>50mA</td> <td>3.0v to 5.0 volts</td> </tr> <tr> <td>100mA to 250mA</td> <td>1.2v to 29 volts</td> </tr> <tr> <td>50mA to 250mA</td> <td>3.0v to 5.0 volts</td> </tr> <tr> <td>100mA to 50 Amps</td> <td>1.2v to 29 volts</td> </tr> <tr> <td>250mA to 5 Amps</td> <td>1.2v to 29 volts</td> </tr> <tr> <td>7.5 Amps</td> <td>3.3v to 29 volts</td> </tr> </table>	50mA	3.0v to 5.0 volts	100mA to 250mA	1.2v to 29 volts	50mA to 250mA	3.0v to 5.0 volts	100mA to 50 Amps	1.2v to 29 volts	250mA to 5 Amps	1.2v to 29 volts	7.5 Amps	3.3v to 29 volts	
50mA	3.0v to 5.0 volts													
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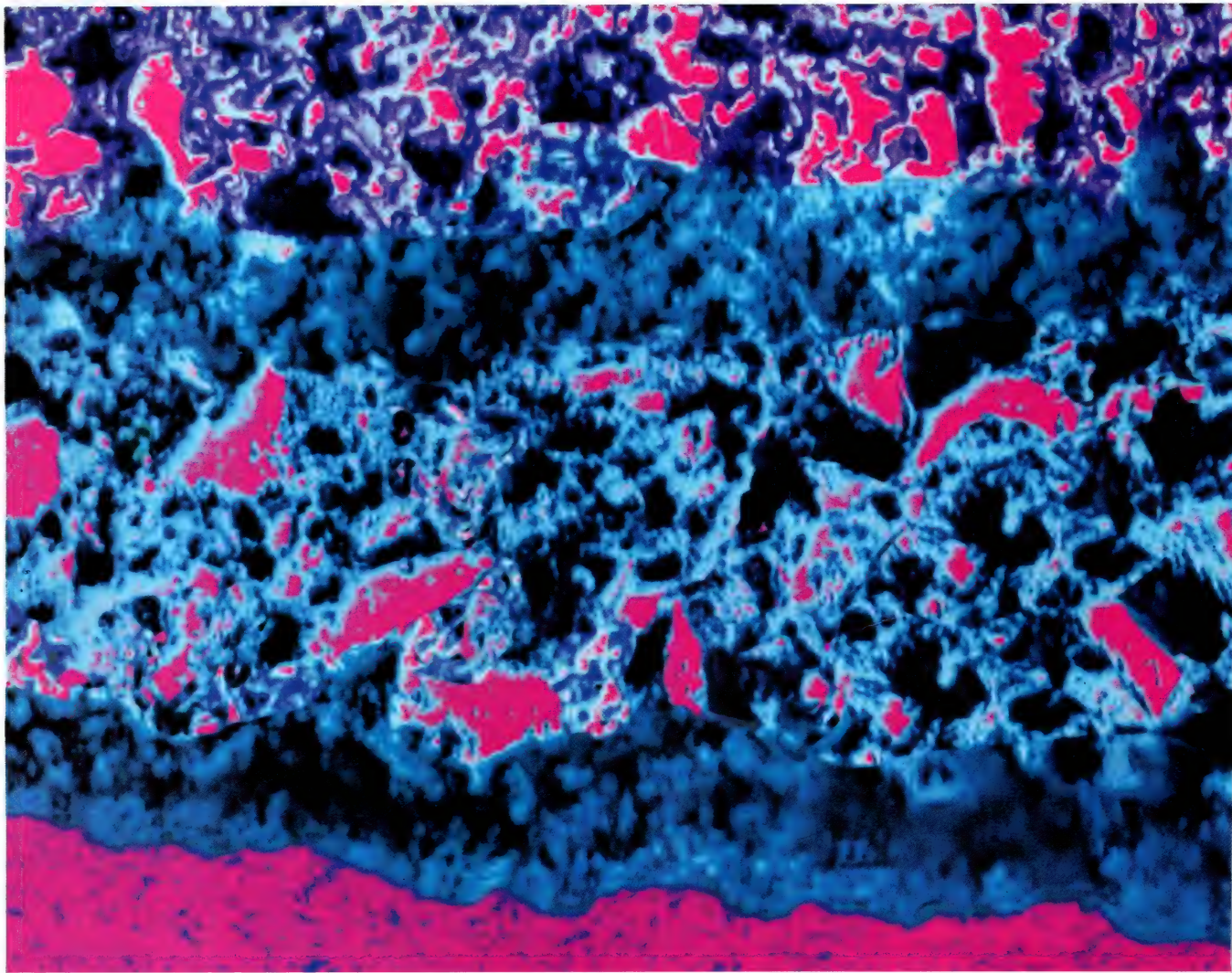
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SIEMENS



Capacity for capacitors

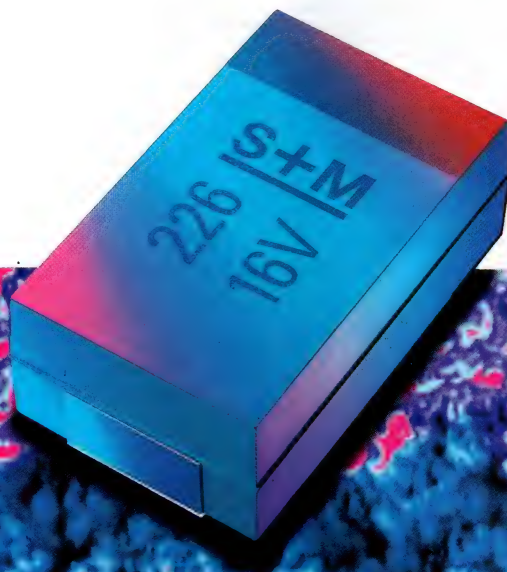
Capacitors from Siemens come in all shapes and sizes and for every kind of rating. That means they range from ceramic capacitors in chip format right up to power capacitors as big as a cabinet - big enough to hold the 5 tonnes of concentrated charge that get modern electric express trains moving.

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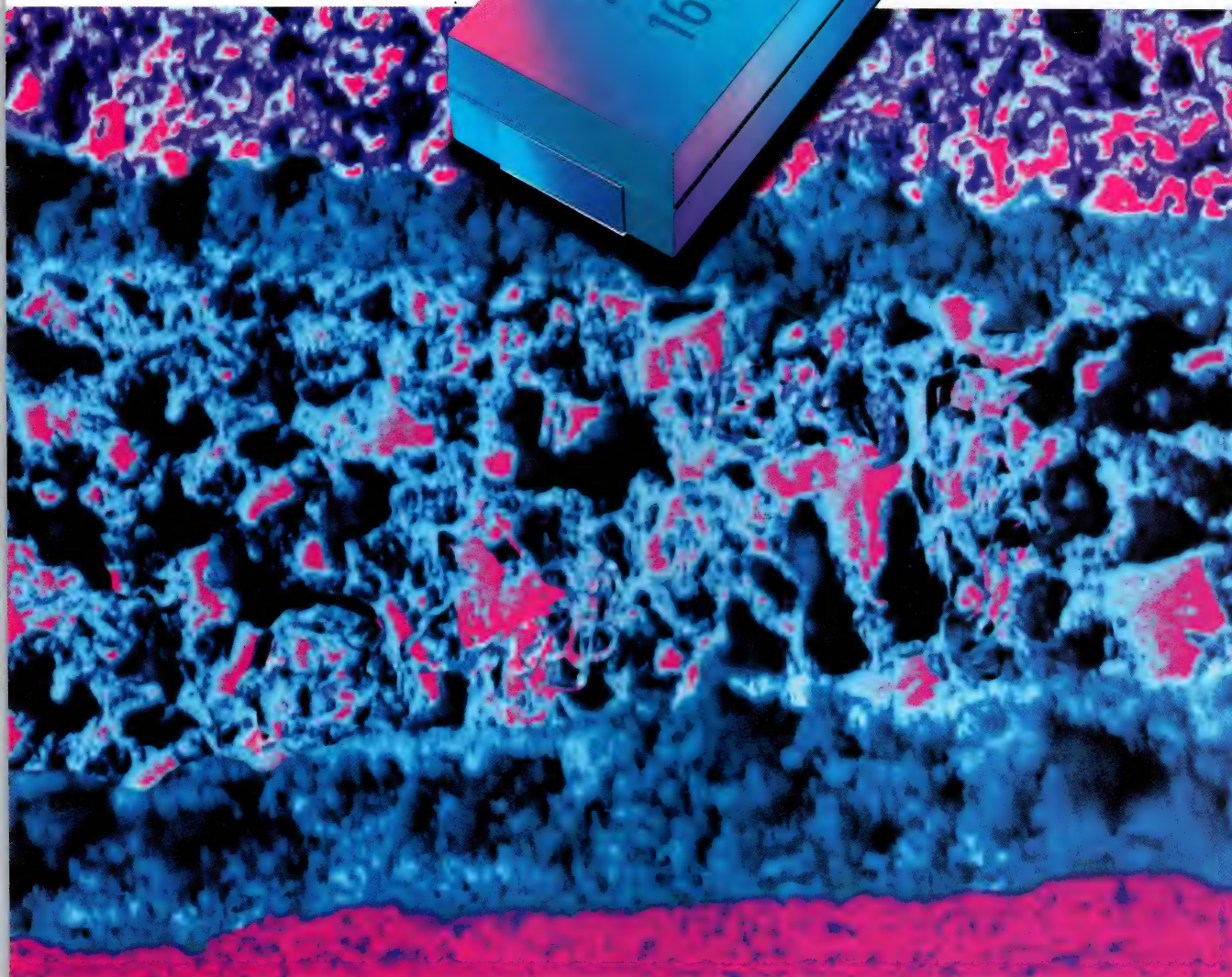
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Photo based on a micrographic view of a tantalum chip

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Little things make a big difference

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PCI GPIB board for Windows 95

National Instruments has announced a high-performance, low-cost GPIB instrument control board for Windows 95 PCs with a PCI bus. The PCI-GPIB can sustain data transfer rates up to 1.5MB/s using the IEEE488.1 three-wire handshake and implements the patented high-speed GPIB protocol (HS488) for programmed I/O data transfers of 3.7MB/s.

The unit includes NI-488.2M software for Windows 95 and will be compatible with the native Windows 95 versions of LabView and LabWindows/CVI. [2470](9180) **ENTER 0411 ON CARD**

Resistance bridge

The Clare Instruments model A309D resistance bridge, available from Macey's Electrical, is designed to be used in the laboratory or on the production line. Incorporating modern four wire dc bridge network circuitry, the resistance of both inductive and capacitive components may be measured easily and accurately. The two wire circuitry may be used for less demanding applications.

Eight internal reference standard ranges cover measurements from 10mΩ up to 1MΩ. Additional terminals enable comparison measurements against an external resistance to be made up to 10MΩ. Depending on the reference range selected, the accuracy of the A309D is between 0.25% and 1.0%.

In order to minimise power dissipation and thermal EMF problems in the test object, the excitation voltage and current are automatically limited. The bridge circuit is protected and its terminals may be used at up to 370V with respect to Earth.

Adjustable set-point trip relays can be provided to give "out of acceptable range" indication, or be used with automatic test system circuits.

A special version of the A309D will also display the mean temperature rise of a copper conductor, and is often applied to motor or transformer winding measurements. [2470](921)

ENTER 0412 ON CARD

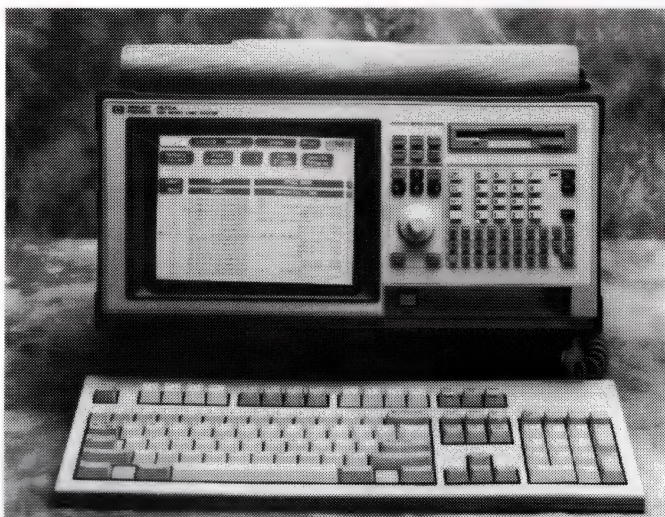
Benchtop logic analysers

The three models in Hewlett-Packard's HP 1670 benchtop logic analyser series offer software developers 64K of acquisition memory with an option to increase to 500K. Deep acquisition memory lets software designers see long periods of code execution — useful because the cause of a problem may occur much earlier than the symptom.

Ethernet LAN capability eliminates the difficulty of verifying logic-analyser data against design information. When benchtop logic analysers are used as stand-alone instruments, they have no direct connection to the computing environment. This forces designers to lay a hardcopy printout of logic-analyser data next to the computer screen to make side-by-side comparisons between their hardware simulations and their logic-analyser data. The addition of Ethernet LAN capability eliminates this inefficiency and provides two additional benefits — it allows logic-analyser users to consult more easily with others when troubleshooting a problem, and an X Window interface lets users who have separate lab and office areas choose where they want to work.

The addition of a 290MB hard-disk drive and the Ethernet LAN allows design teams to use the HP software analyser. They can compare a code trace from a microprocessor with the original high-level-language program, such as C++, easily. Cross-compiling the source code to show the high-level-language constructs beside the equivalent assembly language's address number is no longer necessary. The result is that matching a hardcopy of the inverse-assembled state listing address-for-address to the cross-compiled output becomes a thing of the past. [2470](22)

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Overpowered

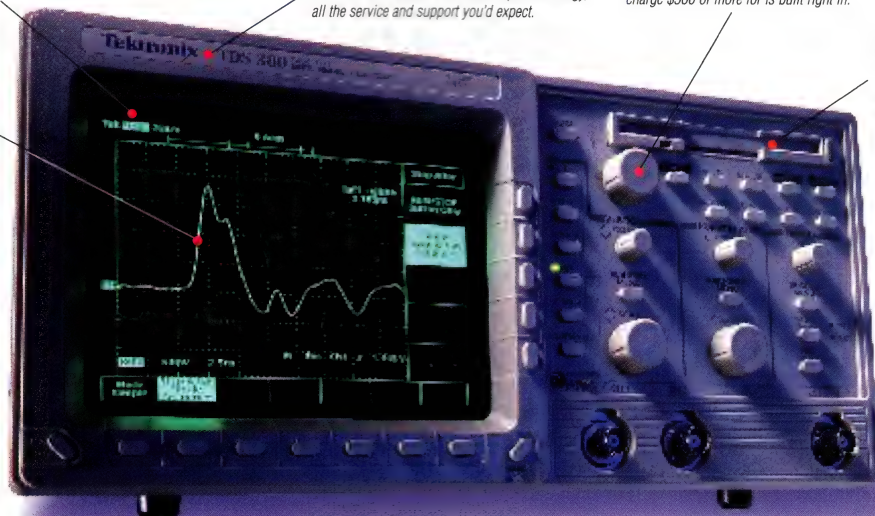
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Series also offers FFT and Disk Drives - features others charge hundreds of dollars more for.

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Testing fibre-optic cable

A half-dozen simple but rigorous tests performed with an optical time-domain reflectometer and an optical power meter can characterise the optical transmission performance of fibre-optic cables.

A definitive repertoire of tests, known as the "essential six", can aid the inexperienced system engineer. Using an optical time-domain reflectometer (OTDR) test instrument, these tests analyse the operation of fibre-optic cables and their conveyance of transmitted light signals. The light signals may be used to carry digital, analogue or light-wave signals, but the tests of the conduit are essentially the same.

Whatever the end use of the fibre-optic cable, its fundamental signal-carrying characteristics relate to the nature of light. When it is being transmitted over a fibre medium, light tends to travel in a straight line. In addition, it refracts (bends) because of speed variations as it passes from one transmission medium to another. The back scatter effect — the tendency of light to spread or bloom in all directions — also affects its ability to carry information. All these light characteristics can have an impact on the transmission of data-bearing signals through fibre-optic cable.

Fibre-optic cables are generally installed in the air, underground and in buildings. The cables are coupled to optical or electronic equipment or to other cables by splices or connectors. The OTDR verifies that the fibre is undamaged before and after installation, splicing and the attachment of connectors. Upon fibre-optic cable activation, the OTDR is used to check, test and analyse the fibre's signal transmission parameters.

The basics

Six basic test procedures measure distance, fibre loss, event loss, link loss, event return loss, and link return loss. These procedures are essential because they are implemented at all four levels of fibre operations: pre-installation, installation and acceptance, maintenance, and restoration.

An OTDR can be used to accomplish the six test procedures. In addition, clean connections on the fibre media under test are imperative. All six test procedures will prove inaccurate or impossible to accomplish if the fibre-optic connectors are dirty.

Distance test

The optical distance between one point and another depends on definition. For example, the distance could be the fibre-cable length between a transmitter and a receiver, or it could be the fibre-cable length between two splices. An OTDR is the test instrument used worldwide to measure optical test events either automatically or manually. Events are detected as disturbances in the OTDR's relatively linear trace display.

To measure optical distance between two points, the OTDR launches a laser generated light pulse down the fibre at the transmission end of the cable. The

instrument then detects the back scatter returned from the fibre and any reflections from shiny surfaces. It measures the time taken by the light pulse to make the round trip on the fibre and calculates the distance from this time measurement.

One thing to note with this test is the difference between real and apparent distance. The optical, or apparent distance, is the distance reading registered on the OTDR, and is always longer than the real distance. One reason for the difference in real and apparent distances results from the undulation of fibre as it resides within loose-tube cable, which adds to its length. Another reason involves buried cable as it winds within a trench, thereby producing a longer optical length.

Fibre-loss test

The backscatter trace is a representation of the fibre itself (*Figure 1*). The slope of the backscatter trace discloses

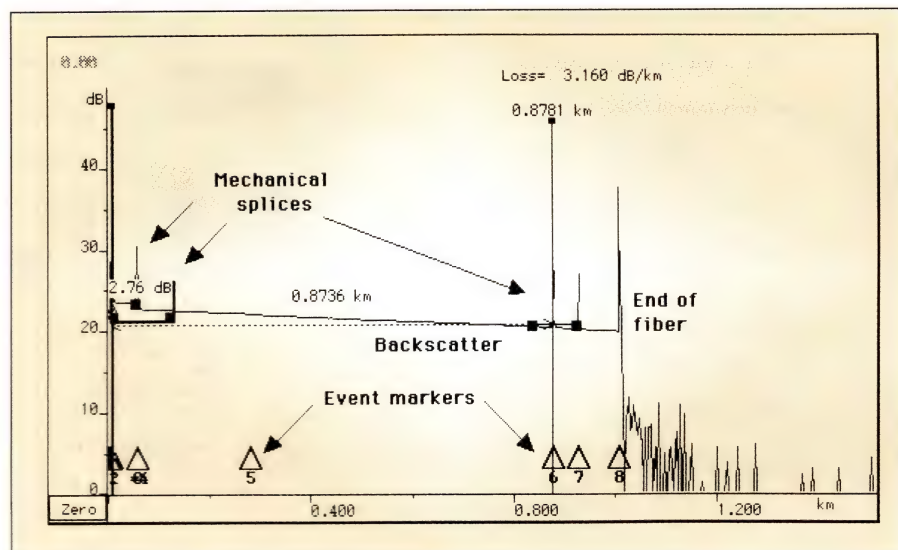


Figure 1. This OTDR waveform shows the beginning of fibre, backscatter, mechanical and fusion splices, end of fibre, and loss and distance readings.

that less and less light is being reflected back as the length of the fibre increases. This slope represents fibre loss, a manufacturer's specification. Typical fibre-loss measurements are given as the amount of light (in decibels) lost per kilometre. For example, a long-haul telephone fibre might lose 0.15dB/km whereas a multimode local area network fibre could lose 3dB/km. Fibre loss is always measured along a featureless section of backscatter with no events to skew the calculation.

Event loss

A test "event" is a disturbance that occurs above or below the backscatter baseline. Splices, connectors, bends and cracks are typical events that produce trace anomalies on the OTDR display. Normally (but not always), an event results in a loss of light. There are two types of events — reflective and nonreflective. The spikes along the baseline indicate a reflection. Because more photons appear and thus exceed the normal backscatter level, a mechanical splice or the end of the fibre is revealed. Other causes of reflections are connectors and fibre cracks.

A drop in backscatter level with no reflection indicates a fusion splice. In this case, all the reflective surfaces appear to be melted together. This condition reduces backscatter but creates no reflection. Other non-reflective events include macro bends and micro bends.

A rise in the backscatter (Figure 2, event 2) across an event is known as a gainer and is caused by splicing two fibres of different specifications.

Events that occur along the fibre become important when a fibre-loss budget is calculated. Only a finite amount of light is launched by the transmitter. Consequently, if the receiver does not receive enough light, a major cable problem may have occurred.

Link loss

Link loss is the total amount of light lost between two points. A link can be the distance between events or between two end points. Total link loss is typically specified when it directly affects the loss budget. If the link loss is a high value, then specific events are consuming light.

Return loss

Return loss is essentially the light lost because of reflections back towards the transmission or source end. The shiny surfaces of connectors and mechanical splices reflect light. Some of this reflected light returns to the source. Any transmitted light that does not reach the end of the fibre is lost. An OTDR trace displays return

loss as the height of a reflection.

Return loss is defined as the ratio in dB of the incident power to the reflected power. Return loss is always expressed as a positive number:

$$ORL = 10\text{Log}(E_{\text{inc}}/E_{\text{ref}})$$

In contrast, reflectance is defined as the ratio of reflected power to the incident power or the inverse of the return loss formula. When expressed in decibels, reflectance is a negative number. In addition, reflectance can be expressed in terms of density or as a percentage.

In reality, these terms mean noise! The reflected light travels back to the source, reflects off the input and makes another round trip. To a digital system, the reelected light looks like a bit error. To an analogue system, such as cable TV, reflected light creates sparkle. The higher the reflection value, the more dramatic the noise level becomes.

test is important because it quickly and easily determines product acceptance or rejection before system usage.

The first pre-installation test should check for correct cable distance, confirming fibre length and integrity. The next measures fibre loss to confirm the manufacturer's specifications and check for material anomalies. If a fibre defect or problem arises, the cable can be readily returned to the vendor at this early receiving stage. Defects found after the fibre cable is installed or buried are expensive, time-consuming and labour-intensive. Consequently, tests at this stage are generally done at the request of the end user. The system supplier must substantiate and document that before installation the fibre is free from defects. In this manner, a product test trail can corroborate that the fibre was received in acceptable condition before any possible

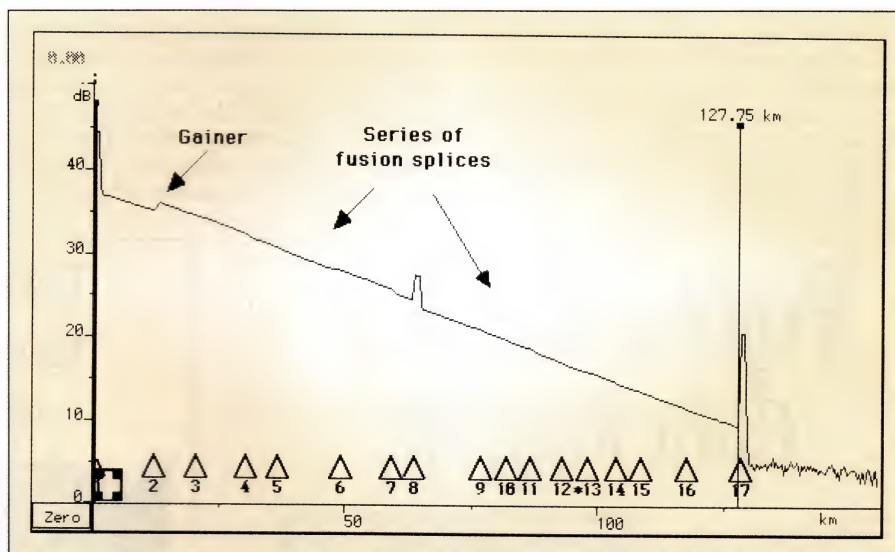


Figure 2. This waveform shows a long series of fusion slices, mostly undetectable without the aid of powerful algorithms.

Link-return loss

Link-return loss is similar to link loss. It is the total amount of reflected light in the link (Figure 3). Therefore, link-return loss is often used as an acceptance test. If the total amount of return loss is below a certain level, the link is assumed not to contain a single event reflecting above specification.

Test usage

These six essential tests should be used to test fibre during pre-installation, installation and acceptance, and for maintenance and restoration.

A pre-installation test should be performed when fibre-optic cable arrives from the vendor. This receiving type of

installation damage.

Installation and acceptance testing should involve all six tests. Link loss and link distance measurements should be made first. If overall link loss measures too high, then the abnormal event loss is tracked. If link loss levels are acceptable, then link-return loss and event-return loss tests should be performed. Collectively, all these tests should disclose whether the fibre will pass enough light for the receiver to operate properly, have minimal reflections to prevent noise, and document the distances needed to establish proper access to the system at a later date.

A capable OTDR should be able to detect events on the fibre that cannot be detected visually. These events should be marked by the OTDR, and the data

TEST & MEASUREMENT

for each event must be retrievable. Thorough test documentation is imperative; a discernible data representation of each fibre within the system — not just an image of multiple linkage — should be indicated. Test documentation can be stored on a floppy or hard disk file, or printed as a hard copy with all test results labelled. The data points acquired by the OTDR can be retrieved and viewed immediately or later on an OTDR or a personal computer.

Maintenance testing consists of comparing archived test results with current tests. It may also consist of checking for degradation of connectors and splices as a result of daily mobility, or of looking for environmentally induced changes such as macro bends and micro bends. Comparing the latest test acquisitions with archived results can also be made with OTDR differential software.

Restoration testing attempts to discover why light is not getting to the receiver, or perhaps why the light is corrupted or degraded. Common light-transmission problems involve a high loss event, such as a broken fibre, a pulled connector or a failed splice. In some cases, a high return loss on a splice can cause a high bit error rate.

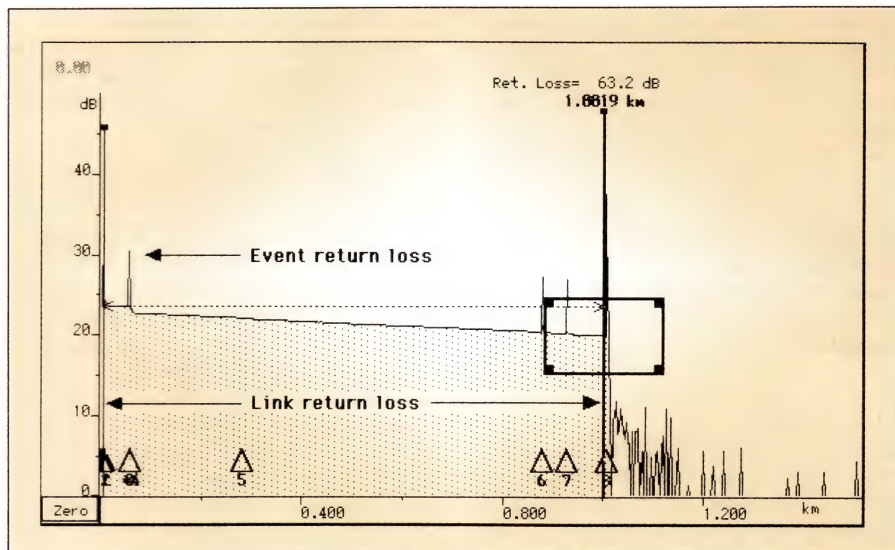


Figure 3. Return loss is shown as the height of reflection. Link return loss is shown as the total amount of light being reflected back to the source.

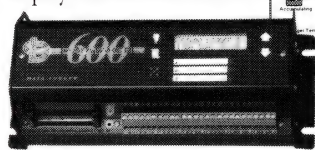
Logical, proactive test processes help considerably in restoration testing. For example, a restoration testing sequence might first check the light level emanating from the transmitter. If the light level is acceptable, a check of the integrity of the fibre is in order. If the fibre

checks out, an electronic problem might exist in the receiver. For testing purposes, optical fibre can be thought of as a light conduit; therefore, keep the tests simple. □

This article was supplied by Tektronix.

Point-and-click data logging

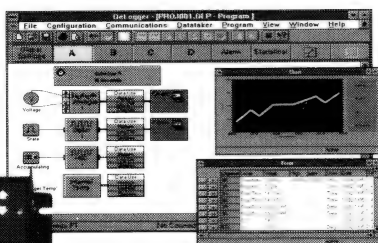
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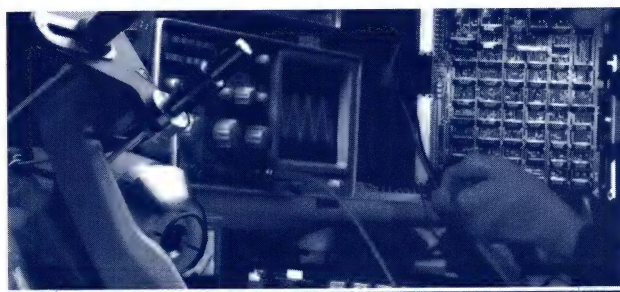
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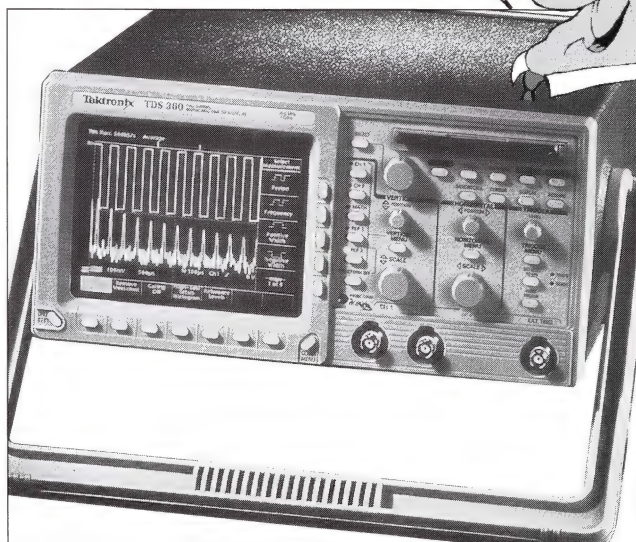
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Tektronix' new TDS-300 Series offers the user a choice of 100MHz, 200MHz and 400MHz digital storage scopes with the powerful capture, display and measurements facilities necessary today and vital tomorrow.

- In-built FFT for simultaneous time and spectral display
- In-built MD-DOS™ floppy disk drive for saving waveforms instantaneously
- Five times oversampling per channel
- Dual converters - one per channel
- Delayed Timebase



With the breakthrough new TDS 300 Series, Tektronix redefines the price-performance benchmark in oscilloscopes. Numbers tell the story: at sample rates of 500MS/s, 1GS/s and 2GS/s for scopes with bandwidths of 100MHz, 200MHz and 400MHz, Tektronix offers you the highest level of performance, "Digital Real Time" (DRT).

DRT, a Tektronix exclusive, lets you instantaneously display every minutest glitch and jitter in both single-shot and complex waveforms, on both channels simultaneously.




At this level of reality, you'll see things the other scopes can't even capture. The new TDS 300 Series also offers FFT on-screen real-time spectral display, and Disk Drives for conveniently saving waveforms and data at the push of a button - unique features in this price range.

In order to help you see not just what a traditional analogue scope shows you, but also erratic or unexpected components buried within the signal, the new TDS-300's include a host of display and capture modes: sample, envelope, average, peak detect with glitch capture,

vector display, dots display, variable persistence/dots accumulate display along with XT & XY display.

As well, the TDS 300's include 21 automatic measurements from frequency and time measurements to RMS voltage calculations and various maths functions.

The biggest breakthrough, though, is in the number on the price tag. The TDS 300 Series starts at \$3,700 (ex-tax). For this price, you get a level of performance earlier reserved for scopes twice the price.

	TDS 340, \$3,700 100 MHz, 500 MS/s, DRT, FFT
	TDS 360, \$5,200 200 MHz, 1 GS/s, DRT, FFT, Disk Drive
	TDS 380, \$6,800 400 MHz, 2 GS/s, DRT, FFT, Disk Drive

Tektronix

AEE readers quote	5700
WNIE readers quote	F200
EN readers quote	60

Handheld 100MHz Digital Storage Scope

Tektronix TekScope combines a full featured 100MHz Digital Real Time oscilloscope with a True RMS digital multimeter and data logger, in a rugged, affordable, battery operated instrument.

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Fast, Bright Display

Compare TekScope's display: its as easy to read in a **tunnel**, as it is to read in the **blazing sunlight**.

See for your self TekScope's unique fast responding LCD display: its like watching a standard CRT display.

Dual ADCs - One per Channel

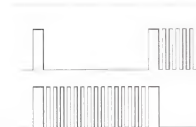
An easy comparison: connect both input channels to the same test point and try capturing a repetitive or even better, a single shot event.



Scope with
Dual Digitisers:
both channels
tied to a single
test point

The diagram above illustrates the captured waveforms displayed by the TekScope: **reality**.

The diagram below illustrates the captured waveforms as



Scope with
1 Digitiser:
both channels
tied to a single
test point:
missing data !

displayed by a scope with a single, time-shared digitiser: how can you rely on such an instrument ?

Each channel is independently isolated from chassis and other channels

"Digital Real Time" technology dramatically reduces aliasing

Wide variety of printers supported

True RMS autoranging DMM with data logging

Dual digitisers for full bandwidth and sample rate on both channels

Ten waveform & setup memories

21 automatic measurements

Bright backlit display, with an extraordinarily fast screen update

Intuitive, icon-based user interface

RS-232 computer and printer interface

Advanced triggering, including pulse width & video



Tektronix

AEE readers quote	5701
WNIE readers quote	F201
EN readers quote	61

EMC Test Equipment

Affordable, In-House EMC Testing

Seaward Electronic of the U.K. have developed an in-house testing package to help manufacturers of electrical equipment to comply with the international EMC regulations.

The testing package comprises the **Expert Consultant** identification and diagnostic software which guides the user through the EMC standards and design diagnostics; the **Sceptre** PC-based spectrum analyser with in-built Line Impedance Stabilisation Network, LISN; and the **Mace** mains interference simulator.

EMC Expert Consultant Software

The Expert Consultant package, compiled by a university team of EMC specialists,

identifies and explains the relevant emissions and susceptibility standards for any product. The diagnostic functions include EMC test methods as defined by the standards.

Sceptre Spectrum Analyser with LISN

Sceptre is designed to measure conducted and radiated emissions to CISPR bandwidths and detector methods. A near field probe is also available. The LISN is rated at 8A.

Mace Mains Interference Simulator

Mace includes facilities for three types of mains interference testing: Voltage Dips, Fast Transients to 4kV and Electrostatic Discharge to 8kV.



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SEAWARD

AEE readers quote	5702
WNIE readers quote	F202
EN readers quote	62

Appliance Safety

Portable Appliance Safety Testers

Regular testing of appliances and maintaining verifiable records is the only way to ensure that appliances are safe and pose no hazards to users.

While safety testing can be time consuming and error prone, the Seaward range simplifies the testing procedure by running automatic test sequences and automatically recording full test results.

The Seaward PATs (Portable Appliance Testers) automatically guide users through a sequence of eight tests: Earth Continuity, Insulation, Flash Test, Load Test, Operation Test, Leakage Test, Fuse Test and Visual Inspection Log.

By simply connecting the appliance to the PAT Tester, tests can be performed in either a manual or automatic sequence. Alternatively, entering a specific appliance test code adjusts the PATs PASS/FAIL points to suit the standards and conditions applicable to the particular item, eliminating operator error. Afterwards, all test results can be automatically transferred to the PATs PC-based record keeping software.



The enhanced PATS+ Software is a more professional record keeping system. It holds information such as equipment registers, check lists, forwards planning facilities, test recording and next test due dates, failure/untested item reports, equipment history and test certificates.

SEAWARD

AEE readers quote
WNIE readers quote
EN readers quote

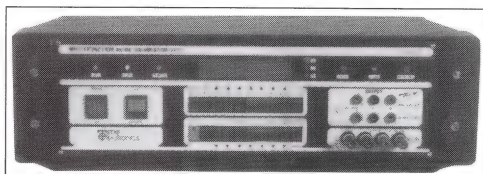
5703
F203
63

AC/DC Calibrator

Programmable Source to 1kV & 10A

The Time Electronics 9821 is an affordable multifunction calibrator with an accuracy of 100ppm/year.

Designed for calibration and service departments as well as production lines, Time's 9821 will output from 2µV to 1kV AC & DC, 20nA to 10A AC & DC, plus 10Ω to 10MΩ, via front panel or GPIB control. Full scales are 19999. PC-based calibration software is available.



Time Electronics

AEE readers quote
WNIE readers quote
EN readers quote

5704
F204
64

Device Programmer

ChipMaster 6000 Intelligent Universal Programmer

A high performance, high speed 48 pin universal device programmer with PC printer port interface and smart pins drivers.

The ChipMaster 6000 is a universal device programmer which works through your PC's parallel printer port.

An on-board processor and FPGA let it handle today's (and tomorrow's) complicated DIP-type silicon PLDs, microprocessors, high density memory chips without adapters.

Over 1200 different devices are supported, including PAL, GAL, CPAL, EPLD, PEEL, MAX, MACH, PLSI, microprocessors, EPROM, series EPROM, PROM and Flash memory. Optional ROM emulator modules support devices up to 16-bits.

Unbeatable programming speed

The ChipMaster 6000's on-board intelligence, SRAM and FPGA reduce system overhead to a minimum, programming an 8-Mbit EPROM in less than 100 seconds (using an 486DX2-66 host PC).

Get to work immediately

The programming software is based on an easy-to-use graphical interface. Like MS-Windows™, the software offers pop-up dialog boxes and on-line help. Included is a host of automatic user functions to speed the programming task.

Device selection is fast: simply type the

Air Parameters Measurement

Multi-Probe Instrument

The Solomat 510e is a multifunctional, portable instrument designed to measure the physical parameters of air.

By simply swapping the probe the four principal Indoor Air Quality indicators can all be measured by this one instrument, quickly and accurately -

- volumetric airflow
- relative humidity
- temperature
- carbon dioxide



Additional probes may be added to measure radiant temperature, carbon monoxide and outside air conditions.

Available probes include:

Temperature, Humidity, RPM, Carbon dioxide, Carbon monoxide, Pressure differential air, Airspeed hot wire, Airspeed vane, Airspeed pitot, Airspeed volume flow rate.

Solomat

AEE readers quote
WNIE readers quote
EN readers quote

5705
F205
65



device vendor's name and part number. File format conversion is automatic, as are the device insertion checks for backward, incorrect insertion and poor pin contact.

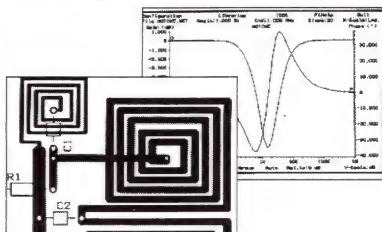
LOGICAL DEVICES, INC.

AEE readers quote
WNIE readers quote
EN readers quote

5706
F206
66

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PCB Parasitics Simulation, RF & Microwave Design



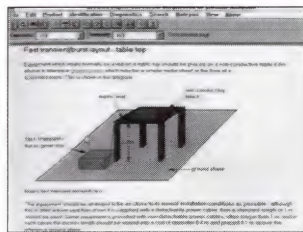
LAYAN is an extremely powerful software package that enables Number One System's circuit simulator, **ANALYSER III Professional** to include in a simulation the parasitic resistances, inductances and both inductive and capacitive couplings introduced into a circuit by the printed circuit board or thick or thin film layout. The effects of external ground plane can also be included in the simulation.

LAYAN works with and requires **EASY-PC Professional XM** and **ANALYSER III Professional** from Number One Systems.

Number One

AEE readers quote	5707
WNIE readers quote	F207
EN readers quote	67

EMC Expert Software



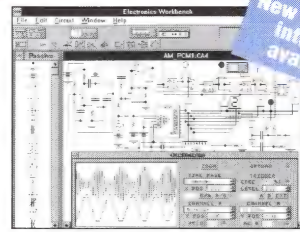
Seaward's **EMC Expert Consultant** is a unique software package which guides the user through EMC standards and design diagnostics.

Containing summaries of the standards and utilising the knowledge of the UK's leading experts, Seaward have developed a package that can identify a product's applicable standards, describe the EMC tests required by the standards, interpret test results and provide diagnostics to enable effective EMC counter measures to be incorporated within a design.

SEAWARD

AEE readers quote	5708
WNIE readers quote	F208
EN readers quote	68

Electronics Work Bench Circuit Simulator



New PROTEL™ interface available

Electronics WorkBench Version 4.1 is a fully integrated schematic capture, circuit simulator and graphical waveform package. Analog and digital parts may be mixed in any combination.

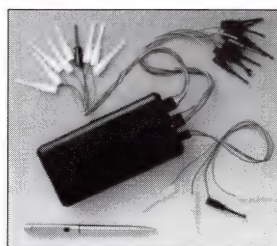
Electronics WorkBench's simple, direct interface helps you build circuits extremely quickly. Try "what if" scenarios and fine tune your designs painlessly.

Four versions are now available: **Professional, Engineering, Educational** and the new low cost.



AEE readers quote	5709
WNIE readers quote	F209
EN readers quote	69

PC-Based Logic Analysers



The **SLA-16** (16 channel) and **SLA-32** (32 channel) are pocket sized, 50MHz logic analysers, requiring only a PC that supports graphics, and has a serial port.

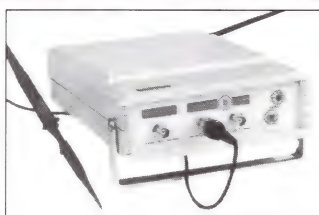
Software features include **Timing Mode**, **Waveform Display Mode** with 2 cursors for time/frequency measurement and **State Listing Mode**.

Hardware features include a variable internal clock (50kHz to 50MHz) and 3 gateable external clock inputs. Word Trace Buffer is 8K.

pico

AEE readers quote	5710
WNIE readers quote	F210
EN readers quote	70

50MHz PC-Based Digital Scope



The TiePie **HS-508** PC interface box provides four high performance instruments in one hardware/software package:

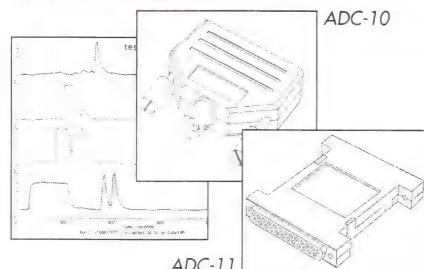
- 50MS/s, 32KB/ch **Digital Scope**
- 24MHz **Spectrum Analyser**
- 5MHz **TRMS Voltmeter**
- 30,000 point **Transient Recorder**

The **HS-508** card connects directly to the PC's parallel printer port. The software provided completes the package by implementing a fully integrated measuring instrument system.

TiePie engineering

AEE readers quote	5711
WNIE readers quote	F211
EN readers quote	71

Low Cost Data Loggers



A range of small, analog interface instruments which connect to the PC's or Laptop's external parallel or serial port.

Software for each instrument includes: Pico's very flexible Data Logger package, plus Scope, Spectrum Analyser, Counter, and TRMS DVM software, as applicable.

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- **ADC-11** 11CH, 10 bit, 18kS/s, 0-2.5V
- **ADC-12** 1CH, 12 bit, 17kS/s, 0-5V
- **ADC-16** 8CH, 16 bit, 200S/s, +/-2.5V
- **ADC-22** 22CH, 10 bit, 15kS/s, 0-2.5V
- **ADC-100** 2CH, 12 bit, 100kS/s, +/-20V

pico

AEE readers quote	5712
WNIE readers quote	F212
EN readers quote	72

AUSTRALIAN **Electronics** **ENGINEERING**

SPECIAL FEATURE

**Printed Circuit Boards &
Materials**



**East Coast now has all the interconnections
following a merger with Circuit Technology Page 46**

Finishing school

New surface finishes for printed circuit boards

Packaging technologies like fine-pitch surface-mount and bondable wire leads are testing the ingenuity of printed circuit board makers. *Dr Jan Friedrich and Rob Irwin look at advances in PCB surface finishes.*

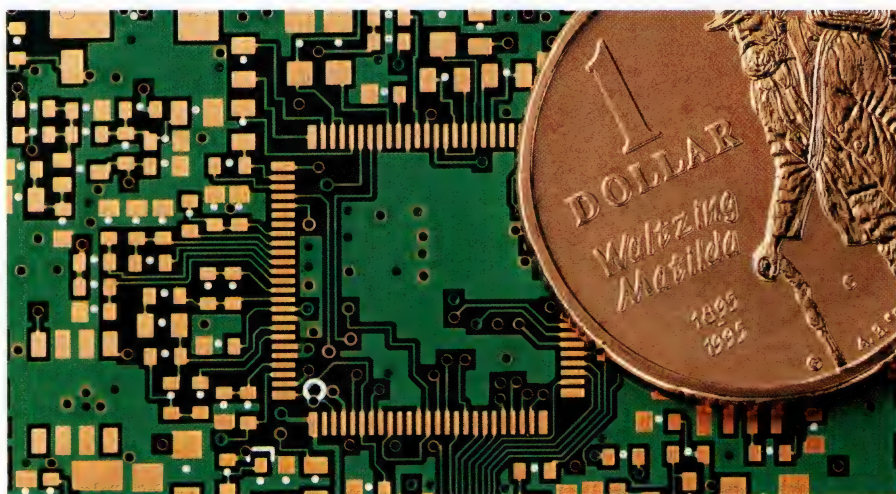
One of the biggest challenges facing printed circuit board (PCB) manufacturers is to come up with surface coatings that can rise to the demands of state-of-the-art devices and manufacturing techniques.

Board real estate is increasing in value as designers try to cram more devices and tracks onto smaller and increasingly complicated boards. Maintaining the solderability of copper pads during manufacture is of paramount importance in making reliable, quality products, and this is where PCB surface finish technology comes in.

When a printed circuit board is first made, the pads and contacts to which components will be soldered are bare, clean copper. Solder readily attaches itself to this clean surface, but over time the surface will tarnish and lose its solderability.

The role of the surface coating is to protect and maintain the solderability of the exposed copper pads and tracks on a PCB during shipping, storage and assembly. Copper corrodes quickly in air and the oxide coating can make the board difficult to solder during assembly. After a board is manufactured it is necessary to coat all the exposed copper to prevent this oxidation and maintain solderability. Because boards may be sitting on a shelf for some months, or even years before being loaded, the surface coating must be durable enough to maintain solderability for these extended periods.

The traditional coating method is a reflow solder process where all the copper — pads, tracks, etc — is coated with a layer of solder prior to the application of the solder mask. This acts to preserve



The move to SMD and fine-pitch devices has driven the search for better surface coating techniques.

the copper during storage and handling and gives good solderability to the pads during later manufacturing stages when components are attached.

The reflow solder finish served the PCB industry well for many years, but the advent of surface mount technology and fine-pitch components showed up a major problem. The solder coating on the tracks can melt during assembly and cause solder bridges on the board. This becomes a real problem on high density boards. As designers demanded higher component and track densities, new approaches to coating exposed copper had to be found.

HAL solder

In the 1980s a technique called hot air level (HAL) soldering was introduced to the Australian printed circuit board industry. HAL is simply the application of hot molten solder to the copper by means of a dip into a solder bath followed by forced air removal of any excess.

Solder is still the coating finish in the HAL process, but one advantage it had over the reflow technique was that it allowed a solder mask to be placed directly over the bare copper and the solder coating applied to the exposed areas. This eliminated the track solder-bridging problems associated with the reflow coating process because copper tracks under the solder mask were not coated in solder. The solder mask over bare cop-

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per (SMOBC) technique followed by a HAL solder coating allowed PCB assemblers to successfully manufacture designs with closely-spaced tracks and finer-pitch devices.

The problems with HAL

Since its introduction, HAL solder coating has virtually become the industry standard for PCB finishing. It is now a mature technology and meets many of the solderability requirements for modern PC boards. HAL, however, is not without its problems.

One of the main disadvantages of the HAL process is that the planarity of the solder coating is difficult to control and this can cause problems during the manufacturing process. When using surface-mount devices, an uneven or rounded surface on the solder coating can make it difficult to accurately place components. The components literally fall off the pads, causing misalignment.

Lack of solder coating planarity can also lead to sealing or gasketing problems with the solder paste stencil. This can result in smearing of the solder paste when it is applied to the pads and may cause shorts in the finished board. It also means the solder paste mask will need frequent cleaning.

Another problem with the HAL process is that it subjects the PCB to high thermal excursions which can lead to warping or twisting. Once again this leads to problems in the accurate placement of surface mount components, particularly with automated pick-&-place machines and solder paste stencilling, both of which require a high degree of board planarity.

New surface finishes

The development of SMOBC and HAL techniques allowed surface mount technology (SMT) to be integrated into mainstream electronics manufacturing. The rise of SMT has been such that it now dominates the industry, but the race to produce finer-pitch devices and cram more and more onto each circuit board has shown up some of the limitations of HAL and pushed the development of new surface finishing technologies.

With fine-pitch devices, the smoothness of the pads is critical in ensuring correct placement and attaining high board yields. While HAL techniques have greatly improved over the years, the search is on for a practical replacement which allows greater control over planarity and thickness.

Low and high function OSPs

In the late 1980s a surface finish emerged which didn't use solder as the coating material. Known as organic solderability preservatives (OSP), the coatings were based on organic compounds, typically imidazoles and benzimidazoles. These compounds form a thin protective coating over exposed copper on the PCB. They also succeed in preserving solderability through one or two thermal excursions during assembly, as long as medium to high activity fluxes are used prior to soldering.

The early OSPs, known as "lower functionality" OSPs, produced a thin flat coating and could protect the copper to the degree needed by medium to high activity fluxes and through one or two thermal excursions during assembly.

Introduced at a time when thermal excursions were being added to the assembly process and when low activity, no-clean fluxes were being introduced, these early OSPs found only limited acceptance and application.

Recently the use of substituted benzimidazoles has radically enhanced the technical capabilities of OSPs, making them a possible alternative to HAL. Developed to provide the degree of copper protection necessary for low activity, no clean fluxes through multiple thermal excursions, substituted benzimidazoles have the chemical capacity to deposit multiple layers of organic material on copper.

In depositing multiple organic layers, substituted benzimidazoles provide a porous-free shield against copper oxidation or tarnish. This becomes critical for low activity, no clean fluxes which have a limited ability to scrub copper prior to soldering. For these, the degree of cleanliness can make a major difference in assembly yield and subsequent reliability.

Multiple organic layers also provide enhanced protection of copper through multiple thermal excursions. The mechanics of organic dissipation through thermal cycles has not been studied in detail, but a substantial reduction in particle size after thermal exposure has been noted and the hypothesis is that after multiple thermal cycles, particles are reduced to the degree that they become volatile. Regardless of the mechanics, practical testing has demonstrated a direct correlation between the ability of an OSP to deposit multiple organic layers and its ability to preserve solderability through multiple thermal cycles.

Metallic coatings

The shortcomings of substituted benzimidazole and all OSPs are that they do not provide wire bondability, a permanent boundary layer against intermetallic migration nor complete coverage of copper pads and/or holes after the assembly process is complete.

In an effort to achieve these ideals the industry is looking towards metallic coatings.

Selective metallisation on PC boards as a final finish is not new. In fact, reflective plating of nickel, gold and other precious metals on exposed copper predates the development of OSPs.

However, most early reflective metallisation processes were expensive relative to HAL, and many were difficult to control, producing marginal yields (it was in fact for these reasons that OSPs were developed).

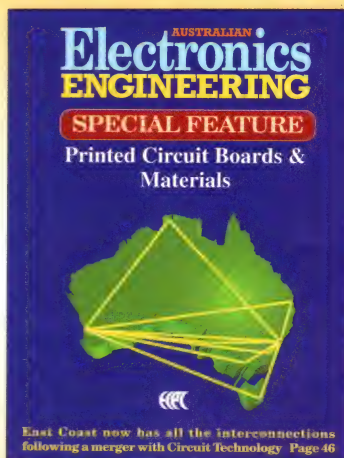
Recent technology has significantly changed the performance and seen an increased use of reflective metallisations.

ON THIS MONTH'S FEATURE COVER

East Coast Printed Circuits of Sydney has enhanced its product range by merging with Circuit Technology (CTA) of Perth. East Coast chairman Grant Evans said "We had planned to relocate in Sydney and invest in a multilayer plant. However when the opportunity arose to merge with CTA, the capital cost and many other synergies made this a very effective way to go.

"The Perth plant (to be known as East Coast-WA) boasts excellent staff and is the most modern in the country. The core capability is in multilayer product and higher-volume double-sided PCBs.

"Our GM, Geoff Price, will relocate to Perth for a period to manage the coordination of our activities. Our Sydney plant has a very strong engineering team who will conduct the design-for-manufacture scans of all incoming design data. Actual PCB production will then be done in the most cost-effective plant for the product order or size. Both sites are ISO9002 certified." [2440](941)



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PRINTED CIRCUITS

Traditional proven processes have been improved to eliminate past process and performance problems and to reduce waste. Nickel gold, nickel palladium and nickel palladium gold processes are all in use today.

Also, new selective metallisations have been introduced which, while less than proven technologies at this point, offer promise. These include palladium plated (by immersion or electrolessly) directly on copper, immersion bismuth, and several organic metallics.

Electroless nickel/immersion gold

One process gaining in popularity is electroless nickel/immersion gold. This is a two layer, gold-over-nickel, metallic surface finish plated onto the upper base by means of a chemical deposition process.

Electroless nickel is an auto-catalytic process using a precious metal catalyst and internal reducing agents for continuous deposit as long as the chemistry is maintained in an active state. Deposits of 2.5 to 5µ are typical.

Immersion gold is deposited in an exchange reaction. As the nickel plated

part is introduced to the gold solution, a chemical exchange occurs replacing nickel on the surface with a thin layer of pure gold. The reaction stops when all the nickel is replaced with gold, thus an upper limit of about 0.2µ of gold thickness is achievable with the process.

While obviously a more complex coating reaction than OSP, the advantages of the Ni/Au process make it highly desirable in some applications, such as PCBs which use very fine pitch SMDs or devices requiring corrosion-resistant contact pads. The Ni/Au process can encapsulate all the copper circuitry on a board without the danger of solder bridges, and is also wire-bondable.

The Ni/Au process provides a tough surface which presents minimal storage or handling problems and maintains solderability throughout the manufacturing process as well as protecting the finished board. The downside however is the relatively high cost.

The future

There is no one technology emerging as a replacement for HAL. Instead, a number of different finishes can complement

HAL for certain applications.

Selecting the appropriate finish requires an understanding of the end product use, benefits and limitations to the assembler, and process considerations for the board shop. As a consequence, everyone involved in the board manufacturing process — board designers, PCB makers, board assemblers and testers — must have an understanding of the benefits and limitations of the different coating technologies.

Communication with all parties involved is the best tool for understanding the hurdles that must be addressed. Working together will ultimately benefit all parties involved in the selection of the right surface finish. □

Dr Jan Friedrich is the technical manager of Sydney-based PCB manufacturer Morris Productions.

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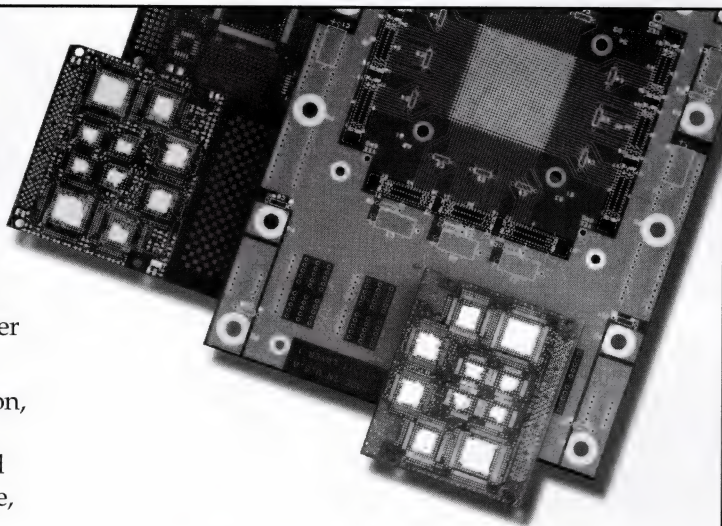
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CAM together

Integrating CAM into PCB manufacturing

Local PCB companies have set about developing CAM strategies based on an understanding of their own requirements. As a result, the tools used vary considerably. To integrate CAM completely, standardisation of data and a greater degree of communication between different sectors of the industry is necessary. *Geoff Griffiths and Rob Irwin report.*

There's no doubt that computer-aided manufacturing (CAM) can dramatically decrease a PCB company's setup and production times as well as lowering costs to the customer. But the road to the successful integration of CAM lies in the cooperation of all sectors of the electronics industry. To gain all the benefits CAM has to offer, the industry as a whole — PCB designers, manufacturers, assemblers and testers — needs to work together to produce an industry-wide approach to CAM.

Australian PCB manufacturers have in general been quick to adopt new methods and technologies, experimenting with ideas like CAM ahead of many manufacturers in overseas countries. Because of the nature of the industry here — lower volume and shorter runs — squeezing the maximum efficiency from personnel and equipment is essential. For the Australian industry CAM has the potential to increase profitability significantly, but there are many problems to be faced on the road to fully realising the benefits.

To date PCB manufacturers have tended to buy equipment and software without an overall CAM strategy. As a result an individual PCB manufacturer's factory may contain a number of different pieces of equipment each operating from different software tools and using different data formats. This situation doesn't make for a smooth flow of data throughout the plant, let alone between the PCB manufacturer and outside design or assembly houses.



A moving probe test machine can verify a board against original design data.

CAM overview

The purpose of having CAM from a manufacturer's point of view is almost self-evident. The aim is to analyse the physical characteristics of a design, find potential fatal flaws and any features on the board that don't comply with manufacturability, and eliminate them before building the board. The process for achieving all of this currently varies from man-

ufacturer to manufacturer and is determined by the amount of data that needs to be created and extracted.

Typically the CAM process begins with customer design data. That data can be input in a number of ways — Gerber files, drill and route files separately, or a PCB design file. However it comes, the data is put into the company's CAM system and then the serious business takes place.

Once a PCB manufacturer has a design captured in CAM it will run a series of design rule checks. These checks will for example, make sure that a hole has enough copper around it, check the inner-layer isolation clearance, check the minimum track width and track spacing to make sure that the board can be fabricated, and check for ink flowing down holes off legends, etc.

Once the board is checked, the manufacturing configuration (the optimum number and orientation of boards that can be fitted onto a standard frame) is determined. The CAM system will then produce the various outputs needed for the manufacture of the boards. Typical manufacturing outputs from a CAM system include: photoplotting for tool sets; drilling files; routing (board profiling) files. Files for automated optical inspection (AOI) and bare board testing can also be extracted.

Benefits of CAM

The introduction of CAM into the PCB industry has potential benefits for both



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manufacturers and customers. From a manufacturer's point of view, typical examples of the benefits gained from the introduction of CAM include:

- **Control of the processes** — Not every manufacturer does the same process in the same way, but with CAM the tooling can be set to suit the process.

- **Decreasing costs through increasing yields** — Because the tooling is optimised for the particular manufacturer's processes, higher board yields are achievable and hence the cost per board decreases.

- **Maximised use of materials** — Manufacturers use standard panel sizes and with CAM have the ability to use real data in the step and repeat process to maximise the images they put in those panels.

- **One data set for the majority of numerically controlled (NC) processes** — All processes, such as drilling, routing and testing, can be driven from the same data set.

Not only do PCB manufacturers benefit by the introduction of CAM systems, their customers gain advantages as well. These include:

- **Reduction in tooling costs** — The need for the customer to supply plots is eliminated, avoiding the problem of having to regenerate plots that were not fit for manufacture and expediting the processing of minor engineering change orders.

- **Typical design data used for verification** — Design data can be passed through a number of processes to verify that the product is valid at each stage of the manufacturing process.

- **Fatal flaw identification** — Potential disasters can be found before any manufacturing is done.

- **Decreasing costs through increasing yields** — This is a benefit to the manufacturer which is shared by the customer in reduced board prices.

Integration problems

From reading the above you may think manufacturers adopting CAM processes have a lot to gain and nothing to lose. In a sense that's true, but at present many of the benefits from CAM cannot be fully realised. It can be a major step forward but it's not one that is painless.

Many of the problems facing manufacturers stem from the relative immaturity of low cost CAM systems and the

lack of good CAM standards across the industry.

For example, current industry standard plotter files such as Gerber 274D and 274X have limited intelligence built into the data. These files are basically graphics files and they don't give a full understanding of the electronic design.

The original design data needs to be carried through to the manufacturing process, but there is currently no universal data translator that can take this data from its design box all the way through to the testing of the loaded board, allowing designers to share the original design data with the manufacturers and testers. There is movement in the right direction, but at the moment it's necessary to do a lot of massaging of the data to get it into a CAM system.

The situation isn't helped by the fact that most manufacturers have CAM systems which have evolved over time. Manufacturers have a mix of NC tools from different vendors. They might buy an NC drill from one company and an optical inspection system from another company. This leads to a lot of time spent developing systems to get the various tools to share common data with each other. CAM tool process development is time consuming and costly. Currently that's a cost manufacturers are absorbing.

One reason for the difficulty in getting tools to talk to each other is that the CAD vendors seem unwilling to produce universal data formats. One reason for sticking to proprietary formats is to stop people changing design seats to another vendor. Many CAD/CAE vendors have

traditionally resisted the implementation of a universal data format because it gives the end user — the customer — the ability to mix and match design seats from different vendors. Fortunately the walls are starting to come down, with many companies accepting the concept of a universal translator. And, more importantly, the people buying the products are beginning to support it.

Future directions

Whilst the physical problems of introducing CAM into PCB manufacturing are gradually easing, another barrier still needs to be broken down — communication between the different sectors of the electronics industry. For there to be a vibrant and sound environment in the next ten years it is necessary for the industry to accept the fact that it needs to share certain information.

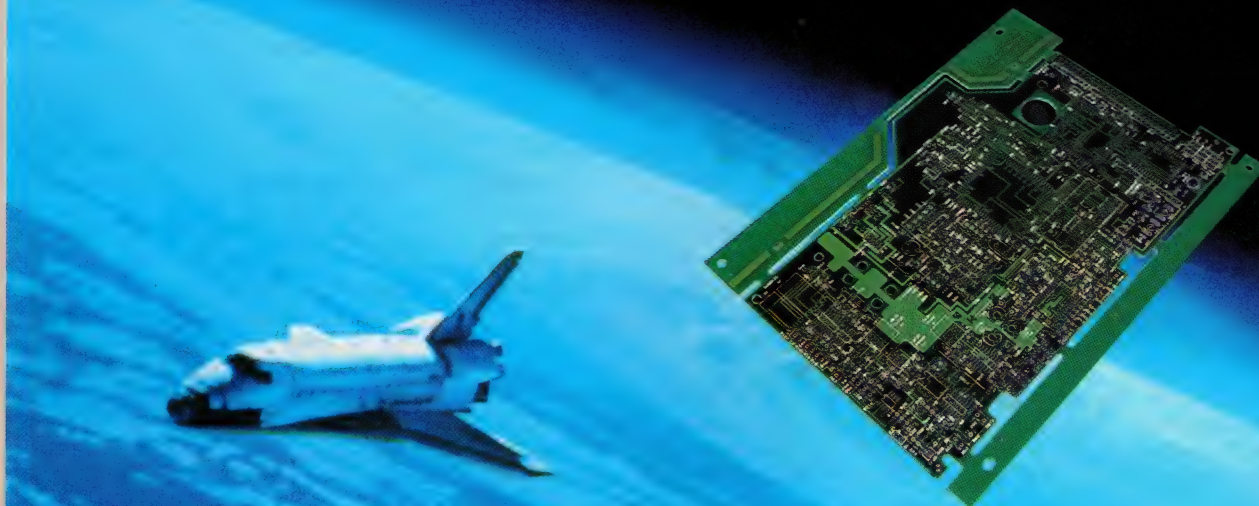
For the benefits of CAM to be fully realised throughout the industry, the following points need to be addressed.

- In the future there needs to be ability to directly transfer data between the various tools and software used throughout the industry. CAD and CAM need to work seamlessly together. One step in this direction is IPCD350, a data translator introduced by the IPC which has been gaining wide acceptance in the USA. Whether this will eventually become the industry standard is yet to be seen, but once the dream of a universal data translator is realised, all parts of the process can work together. Different companies can still compete for work, but the different parts of the manufacturing indus-



Repair stations using CAM data can save time and money when problems occur.

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try can share job data. Those that need to form links to get a product manufactured can share data.

- There has to be more direct contact between CAD and CAM staff. Designers, manufacturers and assemblers can't work in isolation. It is necessary for channels of communication to be developed between the different parts of the industry. Each sector has unique skills and understanding of the various processes involved in manufacturing a product and can help each other produce a cost effective, reliable and manufacturable product.

- Design-for-manufacturing feedback has to flow back from the manufacturer to the designers. If a manufacturer picks up manufacturing problems in a design it is crucial that they go back to the designer and tell them about it. This feedback is necessary if the same problems aren't to occur over and over again. The other side of the coin, of course, is that the designers must listen to this feedback.

- Non-recurring engineering (NRE) charges should be set in accordance with the data supplied. If a customer supplies really good data then they should be charged less. If the manufacturer spends less time in reading data for CAM, every-

one benefits. This would also provide an incentive for customers to talk more to manufacturers before submitting a design for manufacture.

- In the future it should be possible for a manufacturer to run the proposed design through a CAM system to see whether it can be manufactured in a cost-effective way. Manufacturers will have different capabilities and it may be that, for a certain manufacturer, a certain job is not worth taking on. CAM can identify potential manufacturing difficulties before a job is accepted.

Conclusion

CAM offers tremendous opportunity and potential in the local PCB manufacturing industry, and its successful introduction will benefit manufacturers and customers alike. It will also help address future technological trends and challenges. What it requires from the industry, however, is ongoing process automation development and a willingness to communicate. From the customers it requires a willingness both on purchasing and technical levels to overcome the current deficiencies — to work together

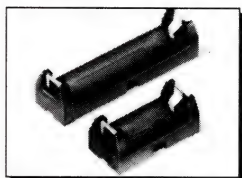
as a unified industry.

The sorts of problems confronting PCB manufacturers in integrating CAM have come about because the CAM process has evolved in the industry over time. The responsibility for these problems doesn't lie with just one sector of the manufacturing industry, but within the industry as a whole. There's been a traditional methodology used in design. The designers would put together a design and then pass it off to the manufacturers. The manufacturer would then pass it off to the loader, the loader to the tester. Each would do their job and not talk to the other. No group ever considered it was their role to talk to the other. We need to open up channels of communication.

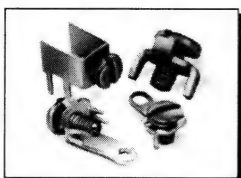
The manufacturer, loader and tester are as important in the design cycle as the designer. They are all critical because at the end of the day the aim is to take a design or concept and put it in the market place. If any one of the people in the loop can't do the job or they don't get the right information, then your product withers on the vine. □

Geoff Griffiths is the engineering manager for Melbourne-based PCB manufacturer Precision Circuits.

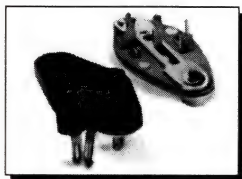
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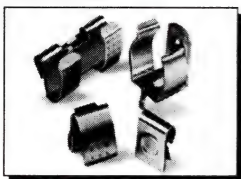
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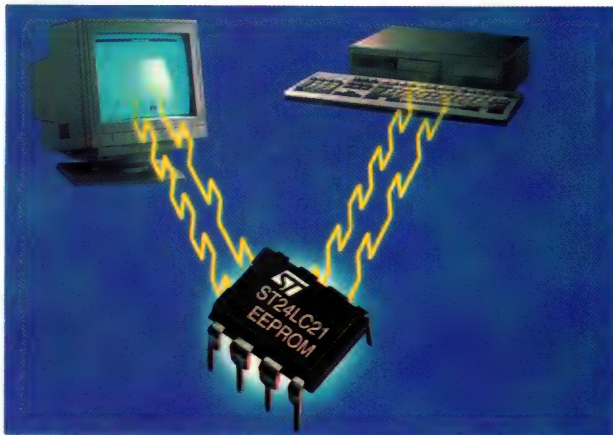


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Serial EEPROM for plug-&-play monitors

SGS-THOMSON has available a 1Kbit serial EEPROM designed for the new breed of "plug & play" monitors. Organised as 128 x 8-bits, the ST24LC21 is compatible with the VESA Data Display Channel (DDC) standard, communicating both in DDC1 (Transmit Only) and DDC2B (12C Bidirectional) modes. The device allows a direct connection between the PC host and the monitor using the standard video cable and 15-pin

VGA connector.

Operating over a 2.5–5.5V supply voltage range, the ST24LC21 offers a hardware write control feature in the bidirectional (read/write) mode.

Available in 8-pin plastic DIP and SO packages, the ST24LC21 is also suitable for identifying any slave connected to the serial plug-&-play bus. [841](1938)

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Embedded microcontroller

National Semiconductor has available one-time programmable (OTP) versions of its COP8 controllers. National claims the microcontrollers provide lower component costs as well as reduced production lead times. The COP8 OTPs are expected to have lead times averaging between 2 and 4 weeks.

The COP8 family consists of fifteen 8-bit embedded microcontrollers which differ regarding peripherals, features and EPROM/ROM sizes. The COP8 family has on-chip features such as serial I/O, highly-configurable multiple I/O lines, power management and halt/idle functions and a variety of timer options. The microcontrollers are used in a variety of applications including automotive, cordless telephony, electronic metering, utility communications and small appliances. [390](135)

ENTER 0415 ON CARD

155Mbps laser diode driver

Veltek has available the Maxim Integrated Products' MAX3263, a single +5V-powered, 155Mbps laser diode driver with complementary enable inputs that allow it to interface with open-fibre-control architecture. An Automatic Power Control (APC) circuit maintains constant laser power in transmitters that use a monitor photodiode.

The driver accepts differential PECL inputs and provides complementary output currents. A temperature-stabilised reference voltage is provided to simplify laser current programming, allowing modulation current to be programmed from 5mA to 25mA and bias current to be programmed from 5mA to 60mA, with two external resistors.

The driver's fully integrated feature set includes a TTL-compatible laser failure indicator and a programmable slow-start circuit to prevent laser damage. The slow-start is preset to 50ns and can be extended by adding

an external capacitor.

The MAX3263 is available in a 24 pin SSOP package in the commercial (0°C to +70°C) temperature range. [841](3946)

ENTER 0416 ON CARD

186/188 microcontrollers

Avnet-VSI has available AMD's Am186EM and Am188EM microcontrollers and the accompanying SD186/88EM demonstration board, a fully functional stand-alone evaluation platform for the new microcontrollers.

The Am186EM microcontroller is a low-power 16-bit embedded IC with enhanced bus interface. The bus design enables the processor to run at up to twice the speed of standard 80C186 processors without an increase in memory speed requirements. The design allows 40MHz operation from 70ns SRAM with no wait states.

The microcontroller also features a set of integrated peripherals including synchronous serial interface (SSI), an 8-bit serial port, programmable I/O port, chip select unit and a demultiplexed address bus which eliminates latch and glue logic requirements. A digital phase-locked loop (DPLL) allows operation at input, removing the requirement for 2x clock input.

The Am186EM is available

in 100-pin thin quad flat pack (TQFP) packaging and plastic quad flat packs (PQFP).

According to Avnet-VSI, the AM188EM microcontroller's high integration, 186 compatibility, lower memory component requirements and a 1X crystal enable it to lower system costs while offering up to twice the performance of comparable 80C188-class microcontrollers. It offers the same features as the Am186EM except for an 8-bit data bus which allows the use of low-cost memory configuration.

The AM188EM is offered in 20, 25, 33 and 40MHz versions and a choice of TQFP and PQFP packaging.

Evaluation support is available for the new processors with the SD186/188EM demonstration board, a fully functional stand-alone test tool. The board features an Am186EM 40MHz microcontroller, PC-host target resident debugger, 256Kb flash memory, and 256Kb SRAM, all designed according to PC/104 form factor.

The board allows evaluation of either the Am186 or 188EM microcontroller's serial port, glueless interface to SRAM and flash, and peripheral attachments. Each kit comes complete with required documentation, cables, adaptor and power supply. [390](65)

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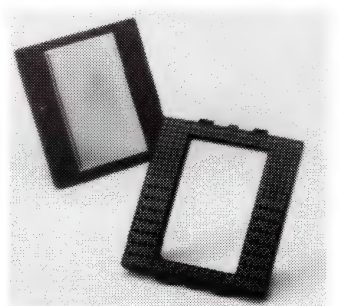
LIF socket for intel P6

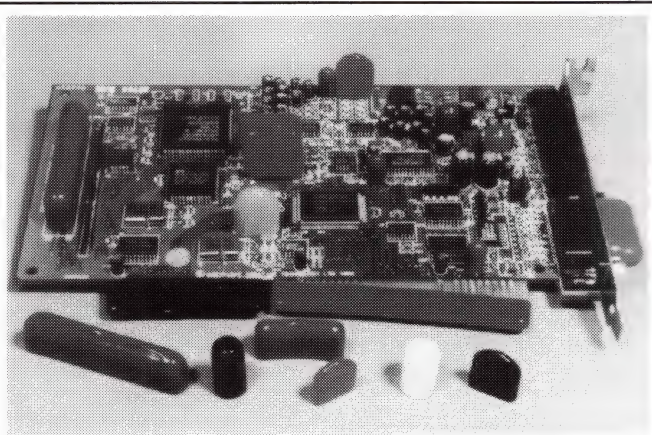
Augat has available a high density LIF socket that accepts the Intel 387-pin P6 microprocessor device. Augat claims the socket is 15% smaller than typical ZIF sockets, which allows more space for components on the PCB and shorter traces to the signal and ground terminals. Unlike ZIF sockets, the LIF socket has no handle, maximising use of vertical space.

The socket features a low insertion force of 37g per pin and a withdrawal force of 15g per pin, and has integral mounting tabs to accommodate a wide variety of heat sink designs. The sockets come in a range of ter-

mination lengths to ensure properly formed solder joints for .062" and .093" thick PCBs. A longer termination design is also available for new PCB design device testing purposes. [794](3948)

ENTER 0418 ON CARD





Flexible closures for PCB assembly

Stockcap has available a range of flexible vinyl closures to cover and mask components on printed circuit boards, such as connector pins, transistors, and standoffs to protect them during cleaning, sealing and dip-coating processes.

The closures can be used to cover a component prior to the application of clear conformal coating onto a PC board, preventing it from being coated. The protective closures are removed once the curing process of the conformal coating is complete.

Special hi-temp closures

are also available for masking components on PC boards going through a solder wave.

According to Stockcap, the ability to mask components through these processes has resulted in a reduction in double handling and an increase in production rates, as previously a PC board would be assembled, then coated and taken back to assembly to have components fitted that could not be coated. [2300](10363)

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Active matrix LCD module

Philips has available the LCDH102T-31 active matrix LCD module recently introduced by Flat Panel Display. It features an integrated meander backlighting system that increases screen brightness, making it suitable for applications in bright surroundings, and a dimmable feature which means it can also be used in darkened rooms when required.

The module offers full VGA resolution (640 x 480 pixels) on a 10.4" (diagonal) screen. It has 24-bit driver electronics, enabling it to display up to 16.7 million colours, affording a high level of picture quality and colour purity. The module electronics enable interfacing with commercially available VGA chipsets such as those from Cirrus Logic, Western Digital and Chips &

Technologies.

Philips says the module's backlighting system offers high brightness (typically 250cd/m² at peak white), low power consumption and a lifetime of 40,000 hours. The module's operating temperature range extends from -5 to 55°C.

The module is suitable for use in industrial PCs and terminals, automatic teller machines, electronic-point-of-sale and test and measurement equipment, multimedia systems and workstations in areas of high ambient lighting. [389](4180)

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1Mb Automotive microcontroller

Intel's 87C196CB microcontroller, available from Hartec, features 1Mb of external addressing and integrated CAN 2.0 (Controller Area network) protocol specification. The 87C196CB combines the Intel 82527 CAN protocol with the MCS 96 16-bit microcontroller architecture on one chip. The CB's 56Kb of on-chip OTPROM is ideal for vehicle dynamics, high-end ABS, and industrial control applications. Hartec says the OTPROM offers manufacturing flexibility and requires no minimum

orders and no long lead restrictions like mask ROM.

Other features of the CB include 2Kb of on-chip RAM and a user-selectable 4x clock multiplier to assist in choosing an external clocking source. The on-chip CAN of the 87C196CB is software-compatible with the Intel 82527 CAN controller. CAN version 2.0 supports both the standard 11-bit and extended 29-bit message identifiers. [390](7327)

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Linear potentiometers

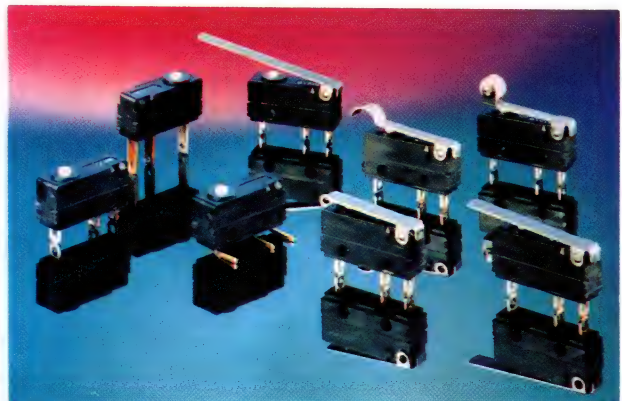
Moog has available the Novotechnik range of linear conductive plastic transducers.

The range is available in mounting styles LWH, LWG and 7LH, and uses a conductive plastic potentiometer as its measuring element. Moog claims the advantages of this element are length, with high resolution to 0.01mm, good linearity to $\pm 0.05\%$, and long life 100x10⁶

cycle capability.

The transducers are constructed from an extruded aluminium section, include a double wiper pick up which provides continuous output regardless of direction and shock, have a DIN electrical plug connector, and are available in sizes from 100mm to 4000mm stroke. [2560](4055)

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Low-travel micro switches

Email Electronics has available Burgess V4D series of sub-miniature switches, for use in pressure switches and thermostats.

Features include a very low movement differential of 0.04mm maximum, a force differential of 0.4N maximum, sealed terminals with 7 options, mounting holes or moulded pegs, a wide range of clip-on levers, silver con-

tacts as standard — with gold plated contacts for low current applications, and snap-on terminal covers.

The switches can also be used with pump controls, mechanical handling machinery, process controls, machine tools and domestic appliances. [810](100)

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NEW PRODUCTS



Clock-tripled 486DX processor

SGS-Thomson has extended its family of ST486DX microprocessors with the introduction of the clock-tripled 120MHz ST486DX4V12HS, which they claim is the world's fastest implementation of the 486 architecture. Fully software compatible with other x86 processors, the device will improve performance in all popular multimedia application programs.

The 120MHz internal operation, combined with state-of-the-art features such as write-back cache, 486 Float-

ing Point Unit and a power saving feature via its System Management Mode, makes it suitable for PCs running the new 95TM operating system.

The device is built using a proprietary 0.35 micron HCMOS process that features low power consumption and thermal dissipation. The operating voltage of 3.45V is compatible with all standard motherboards and the pin-out is compatible with standard sockets without modification. The volume availability is planned for early 1996.

[390](1938)

ENTER 0424 ON CARD

Micro PC enclosure

Priority Electronics has released the MBPC-641 Micro Box Half Size IPC Chassis, a 4-slot IPC chassis for embedded control systems or other limited-space PC control applications. Its small size makes it suitable for vending machines, mobile computer systems and stand-alone con-

trollers. It provides a 65W power supply unit with main frame to form a complete industrial PC control system. It also includes a power on/off switch. [1250](6090)

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EPROM emulators

Technology Affair has available the TechTools range of EPROM emulators. The range includes the lower cost EconoROM series and the FlexROM series, and Technology Affair says both are designed to significantly reduce software development and debugging time.

The EconoROM series is designed to accelerate the software development process by eliminating the need to remove, erase, program and re-install EPROMs for every software change. They plug directly into the EPROM socket on a target board and emulate the EPROM throughout the development process.

EconoROMs connect to a standard PC or notebook computer parallel port, and are supplied with PC software which allows fast downloading of the target program into the EPROM emulator. By downloading at up to 250K bits per second, a typical 27512 EPROM can be downloaded in approximately two seconds.

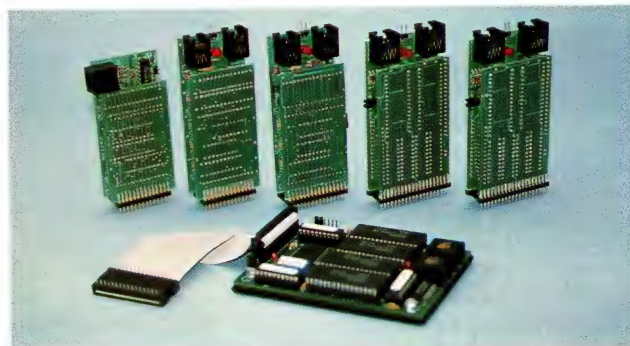
The FlexROM series offers some further features. In addition

to basic EPROM emulation, FlexROM supports FLASH memory emulation, target write-back, arbitration support, memory upgradeability and advanced host software. The target write-back facility allows the target to write to its EPROM, eliminating the need for overlay memory when using a debug monitor or in-circuit emulator.

The arbitration support facility allows full memory read and write access by both the target and host while the target is running. In conjunction with the advanced host software, arbitration support allows shared memory communication between the host and target, supporting more advanced debugging techniques.

The company claims that by eliminating the time wasted waiting for EPROM programming and erasing, and also eliminating the time wasted "debugging" bent pins and bad EPROMs, an EconoROM or FlexROM EPROM emulator can pay for itself within a few days. [388](12256)

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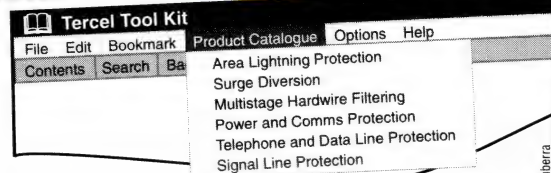
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- GPS satellite referenced time and frequency standards traceable to the U.S.N.O.

The rubidium oscillators and hydrogen masers originate from Efratom Time & Frequency Systems of the USA and Munich and from KVARZ of Russia.

Dindima integrates this hardware into cost effective systems to meet specific requirements. We also manufacture low cost GPS referenced time/frequency systems for embedded or stand alone applications.

Left: Dindima ROU 308 rubidium frequency standard incorporating Efratom rubidium oscillator. Bottom: Kvarz passive hydrogen maser.



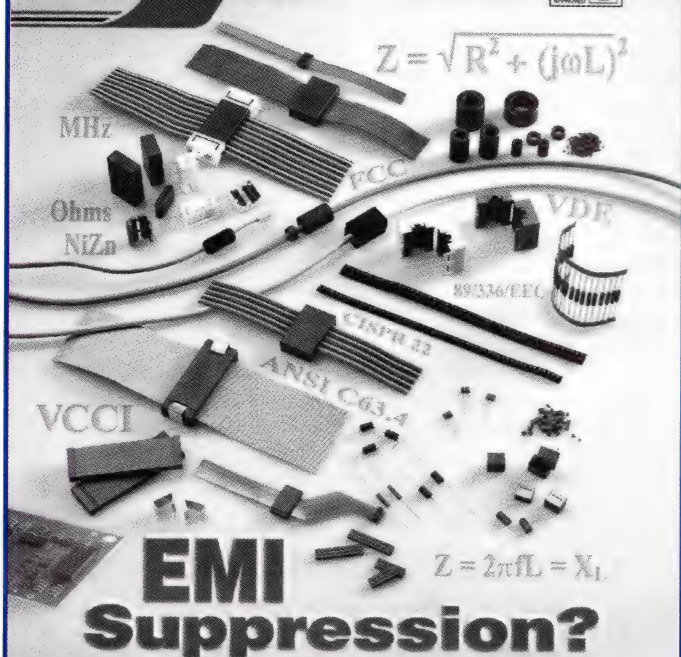
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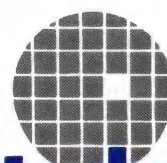


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20" industrial monitors

Advanced Systems has available AYDIN Controls' 20" monitors which they claim provide high performance and a large screen display in a compact package. They can be configured for product designs requiring a small footprint, including rack/console, stacking and desk mount designs. Customised mechanical packages for specific applications, including yielding field immunity up to 10 Gauss, can also be supplied.

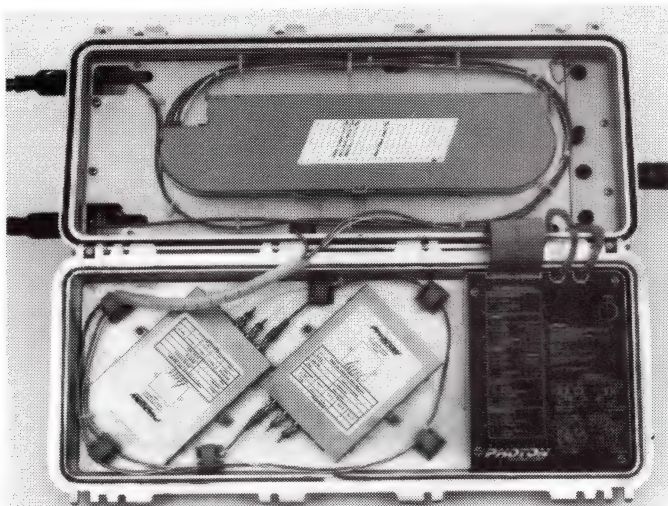
The monitors have high speed synchronisation from 15KHz to 82KHz horizontal (Model 9008 15KHz-38KHz and Model 9010 30KHz-82KHz) and 40Hz to

90Hz vertical.

The microprocessor automatically sizes and centres the screen image for preset and custom graphics modes. It can store 28 user-preferred screen formats and has 12 factory-set formats. This allows the monitors to quickly adapt to a wide range of video standards. The monitors also include energy saving features. Advanced Systems says there is easy access to adjustments, and the 0.28mm shadow mask and Dynamic Focus (DAF) tube with anti-glare screen provide a crisp display. [389](47)

ENTER 0427 ON CARD

Fibre-optic communications systems



Augat has available Photon fibre-optic communications systems for video service providers, that can be indi-

vidually tailored to meet customers' standards.

Photon provides a range of products including 1310 and



Interface modules & supports

MPM Components has available a range of passive, active, and fused interface modules with universal DIN rail fitting from Camden Electronics. MPM says the modules and interface supports are designed to make installation, servicing, and manufacturing quick and cost effective.

Manufactured from Polyamide to UL94-V0, the products are available in the industry-standard green finish, and are designed to provide an easy-to-fit interface connection between field and terminal wiring. The passive interface modules come with 45° cable entry screw terminal blocks to optional D-type, or IDC connectors. Eight-way diode and component carrier modules are also available, the diode modules being designed to protect against return voltage transients.

Active modules incorporate soldered or plug-in relays, available with one to 16 poles. The silver-plated changeover contacts on the relays are rated at 5A, 250V ac, and have LED indicators fitted to show relay operation. Shorting links

allow on-site customisation of the multi-pole modules to operate as common, negative or positive, or a combination of all three. For simplicity of wiring, the modules are available with optional screw connectors with 45° cable entry, or plug-in connectors with vertical cable entry.

The fused modules take standard 5 x 20mm cartridge fuses, have individually-wired carriers of two, four, and eight-ways, and come with screw terminal blocks or vertical-mating screw-type connectors. The units are designed for a maximum fuse rating of 3.15A, 250V per carrier, to a maximum of 6.3A per module. Optional modules with fitted LED indicators are also available.

The interface support strips are extruded to 2 metres in length and can be easily cut to size on-site, or pre-cut to order. End caps, end stops, component covers, and DIN rail mounting feet are also available. [394](6203)

ENTER 0428 ON CARD

1550nm analogue transmitters, an outdoor DFB laser transmitter, optical amplifiers, strand-mount lasers, optical receivers and digital equipment for a variety of system architectures.

A range of performance options allows Photon to configure equipment to the aim of meeting the system require-

ments in the most cost-effective way. Off-the-shelf delivery of opto-electronics is available, as well as turnkey packages including design, installation and testing of complete fibre-optic systems. [1590](3948)

ENTER 0429 ON CARD

1 GHz Power...

...at 500 MHz Price!

New 9370 Series from LeCroy adds 1 GHz bandwidth to its long memory - an advanced combination that gives you increased sample rates and performance.



The LeCroy 9370 Series - Power to Grow With!

Model	Channels	Maximum Sample Rate	Memory Per Channel
9370	2	1 GS/s	50k
9370M	2	1 GS/s	250k
9370L	2	1 GS/s	2Mb
9374	4	2 GS/s	50k
9374M	4	2 GS/s	250k
9374L	4	2 GS/s	2Mb

All models have 1 GHz bandwidth. Channel memories may be combined for even greater memory length.

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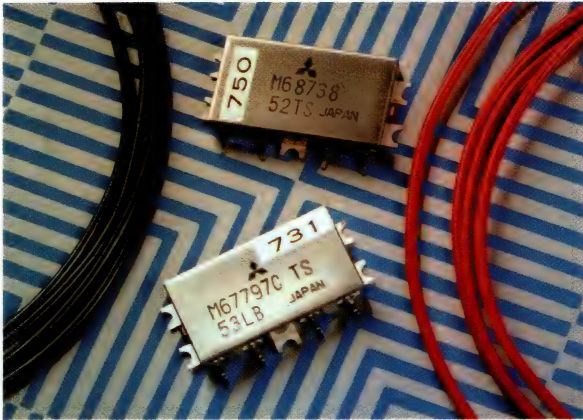
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ENTER 5435 on card

NEW PRODUCTS



Hybrid RF amplifier IC

Mitsubishi Electric has available four-cell silicon MOSFET hybrid IC RF power amplifiers for GSM Class IV cellphones. The thick film hybrid devices feature low power consumption and are available in two versions.

The M68738 operates from 4.8V supplies and the M67797C from 6V. The devices are supplied in 25x12x3.7mm surface mount packaging, and both have a bandwidth of 890-915MHz.

Mitsubishi says the three stage, MOSFET amplifier modules enable a reduction in the number of cells required for the amplifier stage, allowing OEMs to develop small-

er and lighter designs for telecomms applications.

The M68738A provides 37% efficiency at 35.5dBm and the M67797C provides 40% minimum efficiency at 35.5dBm. Maximum input power for both devices is 10mW and maximum output power is 5W, 35dBm. Power consumption is around 1.5mA.

The devices provide a high load VSWR tolerance, with no degradation or destruction of the signals, and high stability without any parasitic oscillation. They operate and can be stored at case temperatures ranging from -30° to +100°C. [841](7998)

ENTER 0430 ON CARD



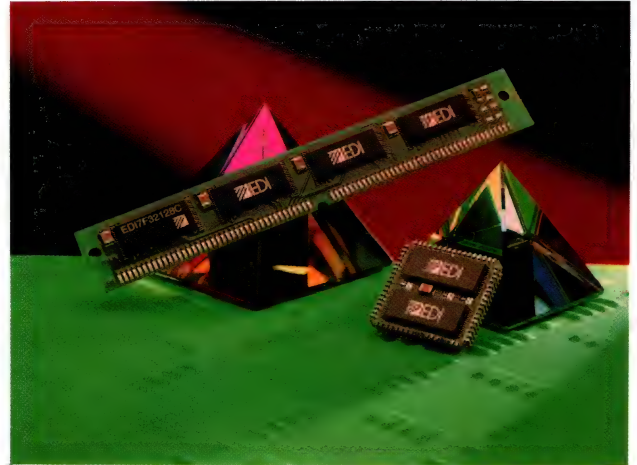
Heatshrink kit

Cable Accessories has available a new kit box for heatshrink products. The kit contains both electrical XLP and SMDW products, with 55mm lengths of black and assorted colours of XLP3, 5, 7, 10, 13, 20 and 25, and three 250mm lengths of SMDW 12/3TK and SMDW22/6TK.

The pre-cut lengths of heat-

shrink avoid the need to carry reels, and Cable Accessories says the design of the box enables users to check at a glance whether stocks of any particular item are running low. The kits are suitable for use by technicians and installers, and for laboratory and maintenance tasks. [1250](5484)

ENTER 0431 ON CARD



High-density 32-bit Flash

EDI, represented by KC Electronics, has announced a range of high-speed, high-density Flash SIMM and PLCC modules based on a JEDEC standard 80-pin SIMM or 68 PLCC pinout, and featuring a 32-bit data bus in capacities up to 32Mbit.

The Flash PROM mod-

ules operate on a single 5V supply and access times 100, 120 and 150ns. The modules are suitable for systems needing a high volume of rewritable, non-volatile storage, such as mapping systems, data recorders and adaptive software control. [841](13122)

ENTER 0432 ON CARD

I-Q Vector modulators

Advanced Systems has available the General Microwave Series 71 & 72 vector modulators. Series 71 is a family of four solid-state 12-bit digitally-controlled vector modulators covering the frequency range 0.5-18GHz in four bands: 0.5-2GHz (Model 7120), 2-6GHz (Model 7122), 4-12GHz Model (7124), and 6-18GHz (Model 7128). Series 72 is the same, but is analogue-controlled.

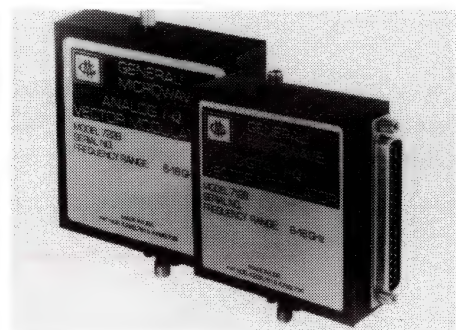
These modulators feature simultaneous control of amplitude and phase so that a signal applied to the vector modulator can be shifted in phase from

0-360°, and/or in amplitude from 0-20dB.

Switching time is less than 500ns, and absolute insertion phase accuracy is more than $\pm 15^\circ$ over the frequency band; fine grain phase ripple is limited to 2° peak-to-peak.

Rated operating temperature range is -54°C - 100°C. Variation of phase with temperature is less than ± 0.1 per °C max., and variation of amplitude with temperature is less than 0.02dB per °C.

The units will operate without performance degradation at power levels up to +20dBm above 2GHz and will survive +30dBm cw. [1540](47)



ENTER 0433 ON CARD

NEW PRODUCTS



3D pad printers

Handel & Sons has available Teca-Print high speed 3D pad printers, which they say can eliminate the need to silk screen, emboss or hand-label product instructions and decorations. 3D pad printers enable manufacturers to print logos, instructions or decorative elements in confined spaces at high speed.

The Teca-Print TPS 101 can print high-resolution images at 4000 impressions per hour, and has a sealed inking system that reduces solvent ink evaporation to a minimum. It can be fully integrated into automatic production lines, or used for single step operation. [790](A)

ENTER 0434 ON CARD

VME adaptors

IR Electronics has available the BIT 3 range of adaptors for connecting various bus types such as Sbus, PCibus etc. to a VME chassis. These adaptors consist of a two-board set and interconnecting cable. One board plugs into the VME host and the other board plugs into the VME chassis. This latter board can also be used as a system controller for the VME chassis if required, but

until recently has been limited to single level arbitration control.

All VMEbus adaptors in the BIT 3 range now have enhanced arbitration functions adding four-level priority and round robin arbitration to the single level arbitration on level three.

BIT 3 adaptors are available for connecting VME to VME, Sbus, PCibus, ATbus, TURBOchannel, EISAbus, GIO64, Qbus, and Multibus I. [794](9987)

ENTER 0435 ON CARD

Full-duplex ethernet controller chip for PCI platforms

AMD has introduced a full-duplex version of its single-chip Ethernet controller for PCI local bus personal computers.

Available from Avnet-VSI, the new PCnet-PCI II single-chip Ethernet controller has all the functionality of a full-duplex Ethernet adapter on a chip about the size of a postage stamp. It can be designed directly onto a PC motherboard, or serve as the heart of a low-cost, high-performance adapter.

The device uses a high-performance bus-master architecture which allows data to be transferred to and from main memory, eliminating the need for external buffer memories. According to Avnet-VSI, the

high level of integration and small size allow users to fit a complete Ethernet design onto less than five square inches of board space.

The PCnet-PCI II controller can be programmed to operate in either half or full-duplex mode depending on system requirements. It is pin and software compatible with its predecessor the PCnet-PCI chip. The device is compatible with 10Base-2 or 10Base-T wiring and contains two sleep modes for power management applications. The integrated hardware implementation of Magic Packet provides the ability for network administrators to remotely wake up sleeping "Green" PCs. [841](65)

ENTER 0436 ON CARD

Asynchronous FIFO memory

Integrated Device Technology (IDT) has introduced two industry-standard asynchronous FIFOs. Available from GEC, the IDT7207 (32K x 9) and IDT7208 (64K x 9) FIFOs give designers the ability to easily extend the life of existing designs. GEC claims this can reduce cost-per-bit by as much as 50%.

The devices are pin and function compatible with all IDT720X asynchronous memories, includ-

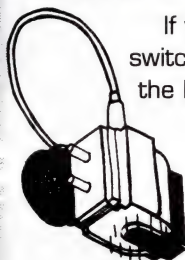
ing the IDT7203/4/5/6. This compatibility gives designers the ability to upgrade to higher densities as needed without redesigning the system.

The devices feature a retransmit capability, simultaneous read and write access, and empty, half, and full flags. They are fully expandable in width and depth, and operate with access times of 15 and 20ns, respectively. [841](13121)

ENTER 0437 ON CARD

Looking for computer monitor repair parts?

Ring Thomas Electronics.



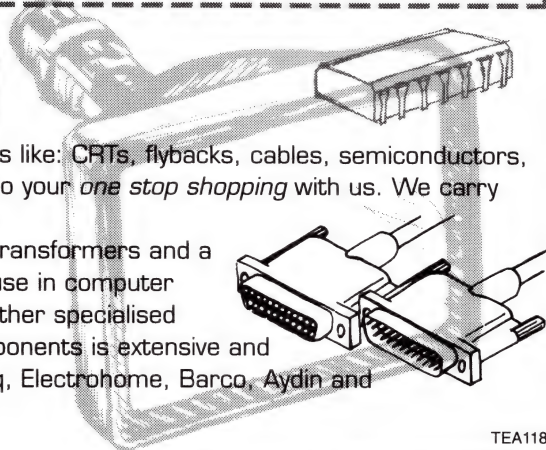
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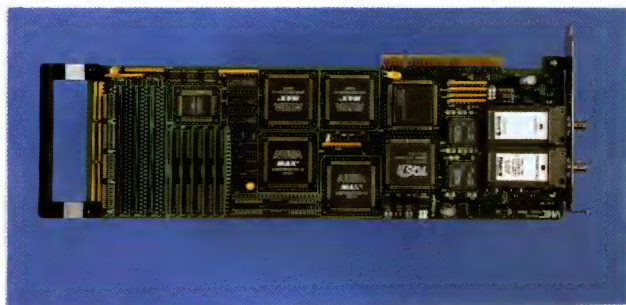
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TEA118



Reflective memory

VME Systems has available the VMIC VMLxxx-5588 family of Reflective Memory real-time network products. The VMIPMC-5588 is the PCI Mezzanine Compatible (PMC) member of the family, and the VMIPCI-5588 is the PCI member. The third member of the family is VMIVME-5588, a VME-compatible board which was released several months ago. All three of these products are network compatible, and can be integrated into a network in any combination.

This family of products

allows computers, workstations, PLCs, and other embedded controllers with dissimilar operating systems, or no operating system at all, to share data in real-time. PLCs and computing equipment from competing suppliers may also be interconnected.

Features of these products include 29.5Mb network transfer rate, 1.3Gb fibre-optic data rate, and support of up to 256 nodes. Memory sizes of 256Kb to 16 Mb are available. [394](954)

ENTER 0439 ON CARD

Enhanced DSP family

Motorola have enhanced their DSP56000 family with additional instructions and on-board hardware. The result is the DSP56300 family, available from Veltex, which retains software compatibility with the DSP56000, allowing a migration path for existing designs. The highly parallel instruction set with single clock cycle instruction execution controls four concurrent execution units.

The data ALU has a fully pipelined 24 x 24 parallel multiply-accumulator with a 56-bit barrel shifter, providing single clock cycle throughput. Conditional ALU instructions have also been added.

The Address Generation Unit supports 24-bit addresses providing 16M address range for Program, X and Y memory spaces. The AGU also supports Program Counter relative addressing, improving the efficiency of operating systems and high level language "C" compilers.

The Program Control Unit provides a hardware stack exten-

sion feature, permitting unlimited subroutine nesting and zero overhead DO loops without programmer involvement.

A six-channel DMA controller can transfer 120Mb/sec at 80MHz to further offload data and instruction transport requirements from the other execution units. The DMA has independent address and data buses and can support read/writes to all peripherals, internal and external memories. The DMA can service peripherals and simultaneously access Program X and Y memories without interfering with the other on-chip execution units.

The instruction cache support is user transparent, provides hardware cache management and implements no access penalty for cache misses. It configures 1K word for PRAM to instruction cache and allows the user to lock or flush individual sectors.

The DSP56300 architecture also offers glueless connection to a PCI bus and external memory and peripherals. The on-board PLL now has a prescaler, permitting a wider selection of

16Mbit DINOR Flash

Mitsubishi Electric has announced its second generation 16Mbit Flash devices based on 0.5µm CMOS design rules and DINOR (Divided bit line NOR) architecture. The devices come in a small package for portable applications including mobile telecomms and computing, as well as for solid state disks and memory cards and resident Flash arrays.

The 3.3V operation devices feature a built-in sequence controller which allows automatic program and erase functions without the need for complex external control. Time to erase is typically 10ms/block. Other functions include software command control, selective block lock, erase, suspend or resume and status register read. Block erase is provided for up to 32 blocks of 64Kb/block. Programming time is typically 1ms/256bytes.

The write state machine (WSM) controls block erase, byte program and page program operations, and operational modes are selected by commands written to the command user interface. A status register indicates both the status of the WSM and also when the WSM successfully completes a required program or block erase operation. A deep power-down mode is also provided to minimise power consumption.

The 2Mx8bit organised devices are available in 80, 100 and 120ns versions. In operation they consume 108mW maximum for read cycles, 216mW maximum for program and erase cycles and 0.36mW maximum on standby. In deep power-down mode, consumption falls to typically 3.6µW.

The devices are available in 48 pin 12x20mm TSOPs and 44 pin SOPs. [841](7998)



ENTER 0438 ON CARD

internal operating frequencies based on a single clocking source. In addition to traditional STEP and Power Down modes, an intelligent power management system automatically powers down unused memories, peripherals

and unused core logic on an instruction-by-instruction basis. An SCI, three 16-bit timers and two ESS (Enhanced Synchronous Serial Interface) at >10 Mbit/sec are also provided. [841](3946)

ENTER 0440 ON CARD

Mentor support for UltraSPARC

In conjunction with the world-wide launch of Sun Microsystems' UltraSPARC-based Ultra 1 family of workstations, Mentor Graphics has announced immediate support of its electronic design automation (EDA) products on the UltraSPARC-based systems and SunSoft's Solaris 2.5 computing environment.

Mentor Graphics partnered with the UltraSPARC design team and worked closely to ensure Mentor Graphics' IC design software achieved successful extraction, verification, module generation, datapath

layout and routing in the design of the UltraSPARC chip. According to Mentor, the cooperation between their engineers and Sun's SPARC Technology Business design engineers helped resolve critical deep submicron design issues. Mentor claims that initial benchmark results on an UltraSPARC 1 indicated a 63% performance increase over a SPARCstation 10/41 using Mentor Graphics' ICrules verification software when executing a full hierarchical design rule check on a 256Mb DRAM. [384](139)

ENTER 0441 ON CARD

3.3V clock drivers

Applied Micro Circuits Corporation (AMCC) has introduced the S3LV3XX family of 3.3V clock drivers. Available from ICD, the S3LV306, S3LV308, S3LV318, and S3LV368 drivers are suitable for systems designed around Intel's 3.3V Pentium processor, the P6 microprocessor, the PowerPC microprocessor family and other high performance microprocessor and telecom/network applications. ICD says the clock drivers easily meet the timing requirements of these systems with low output skew and 1.5ns rise and fall time requirements at frequencies of up to 100MHz.

The drivers are available in 10, 14 and 20 output configurations. The S3LV306 sources 10 outputs at half the input frequency and 10 outputs that match the input frequency. The S3LV308 and S3LV318 supply 20 and 10 outputs respectively, all of which mirror the input frequency. The S3LV368 supplies 14 outputs, six at the input frequency and eight at half the input frequency in the synchronous configuration. In the asynchronous mode, the banks of six and eight will replicate their respective independent inputs. [841](13234)

ENTER 0442 ON CARD

Low dropout regulators

Dice Technologies has available the LX8385 positive adjustable regulator designed to provide 3A output current with higher efficiency than currently available devices.

The internal circuitry of the device is designed to operate down to 1V input to output differential and the dropout voltage is fully specified as a function of load current. Dropout is guaranteed at a maximum of 1.5V at maximum output current, decreasing at lower load currents. On-chip trimming adjusts the reference voltage to 1%.

The device is pin compatible with earlier 3 terminal regulators such as 117 series prod-

ucts. A 10µF output capacitor is required on both input and output of these devices, however this is usually included in most regulator designs. Unlike PNP regulators, where up to 10% of the output current is wasted as quiescent current, the LX8385 quiescent current flows into the load, increasing efficiency. The device is recommended for use in environments of -25°C to +125°C and the LX8385C for 0°C to +125°C. It is available in TO-220 and TO-3 Metal Can packages. [1740](15)

ENTER 0443 ON CARD

EMC emissions test system



Schaffner, represented by Westinghouse Industrial Products, has launched an advanced EMC emissions test system for pre-and full-compliance testing of electrical equipment to international ac power quality standards.

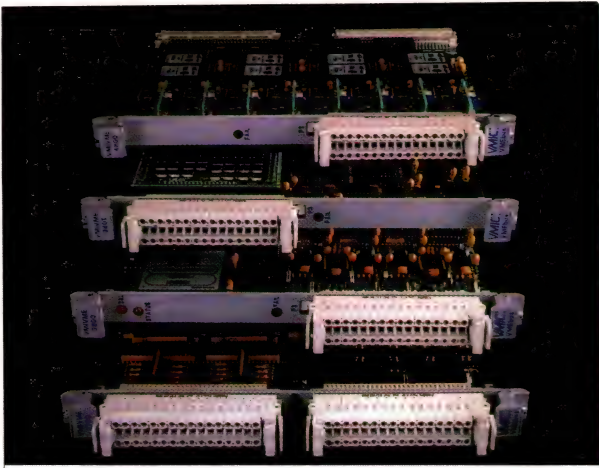
Called ProfLine 2000, the PC-based system provides test and assessment houses, and engineering and quality departments, with a test tool for compliance, pre-compliance and R&D. Compatibility with other Schaffner ProfLine open-architecture EMC test and measurement solutions ensures the system can be readily expanded to address enhanced power requirements and testing to additional EMC emission standards, such as IEC 100048, 11 and 13.

At the heart of the ProfLine 2000 is a Voltech PM3000A002 power analyser which provides real-time measurement of steady state and fluctuating harmonics, and — using the 3.5m impedance shunt — continuous current analysis across IEC 10003's full current specification. A combination of software and

55dB hardware filtering ensures harmonic analysis accuracy better than 0.2%, even with harmonic values down to 5mA. Voltage drop is determined by continuous monitoring of the inphase and quadrature current components of the source voltage.

Voltech's power analyser contains a flickermeter capable of all the measurements required by IEC 10003, including direct measurement of voltage deviation. The NSG 1005 power amplifier ensures an ultra-stable, harmonic-free mains power source by continuous analysis of voltages during the test period, and its generous overload handling minimises reaction to large current switching peaks. Continuous power capacities up to 12kVA, in single or three-phase configurations, are available as standard; other power capabilities up to 36kVA are available by special order, as are impedance networks for Japanese 100V testing requirements. [2470](2815)

ENTER 0444 ON CARD



VMEbus modules

VME Systems has available the VMIC family of industrial I/O products. Incorporating a pluggable module with latching capability, they eliminate the need for special cabling and terminal strips, resulting in the elimination of mass terminal blocks.

Applications include data acquisition and process control, industrial control systems, factory automation, instrumentation, isolated analogue subsystems, intersystem analogue data transmission, and automatic test equipment.

The VMIVME-3800 Intelligent 8-channel RTD/strain bridge, analogue voltage input board with screw terminal interface includes eight differential input channels, on board 16-bit microcomputer, front panel I/O, pluggable user screw latchable connector interface, front panel calibration switch, calibration status LED, self-test, dual-port data registers for minimum host overhead, converter — 12-bits plus sign, and 10, 100, and 1000Hz filter options.

The VMIVME-2700 16-channel optically-coupled digital I/O board with built-in test and screw terminal interface includes 16 optically-coupled inputs, 16 optically-coupled outputs, 1000V channel-to-bus isolation, front panel I/O, pluggable user screw latchable connector interface, eight 16-bit data transfers,

voltage or contact sensing inputs, input ranges of 5 to 125V dc, 300mA current sinking outputs, and 30V maximum output voltage. It also supports built-in tests for both inputs and outputs.

The VMIVME-3801 isolated scanning 12-bit 32-channel analogue-to-digital converter board (6U) with built-in-test and screw terminal interface includes 32 single-ended or 16 differential inputs, autoscanning, continuously digitised inputs and storage of results in dual-ported data registers, pluggable user screw latchable connector interface, 1500V channel-to-bus isolation, supporters real-time built-in-test, overvoltage protected inputs, and 50KHz and 40Hz filter options.

The VMIVME-4800 isolated 8-channel 12-bit analogue output board with voltage or current outputs and screw terminal interface includes 8 fully isolated analogue outputs, 1500V isolation, channel-to-channel, and channel-to-VMEbus, pluggable user screw latchable connector interface, 4 and 8-channel configurations, optical data coupling providing full galvanic isolation, static readback data registers which simplify program control, and program-controlled connect/disconnect operations of voltage outputs for assisting system testing. [394](954)

ENTER 0455 on card

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Mobile radio analyser now handles SS#7



The MA-10 mobile radio analyser from Wandel & Goltermann, designed for GSM, DCS 1800 and PCS 1900 networks, has been expanded to go beyond the A_{bis} interface and cover the interfaces used by signalling system no.7. This PC-based analyser running under Windows now supports the protocols of all fixed-network interfaces. Protocols supported include LAP-D, RSL, O&M (Ericsson, Nokia, PKI, Siemens), MTP, SCCP, ISUP, TUP, BSSAP, TCAP and MAP. Each of the maximum of four PC plug-in boards in the analyser can simultaneously process 10 signalling time slots on the A_{bis} interface or two signalling time slots with load sharing via four connections on the other interfaces.

The graphical call trace facility, layer

1 bit error measurement capabilities, PCM alarms, symbolic display of the time slot usage, and manufacturer-specific A_{bis} simulation programs make the MA-10 suitable for use when installing, maintaining and/or optimising mobile radio

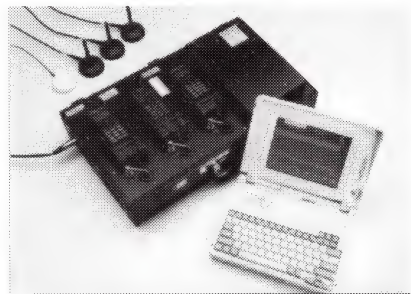
networks. A new application allows statistical processing and individual display of all messages occurring on the A_{bis} interface along with their identification parameters. Standard spreadsheets can be used to process the data. [2470](72)

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Digital mobile measurements

The comparative measurement system TS9958V from Rohde & Schwarz, housed in a compact case, is a system for simultaneous network quality analysis on up to three mobile test telephones. With a minimum of time and cost the user may obtain a variety of quality parameters for ensuring economical use of base stations. The system may be fitted with any combination of GSM900, DCS1800 and PCN1900 test mobiles and can be easily matched to the various measurement tasks.

Applications of the measurement system include an objective comparison of different network parameters (net quality analysis), detection of gaps in coverage and of interference in several networks at the same time as well as simultaneous measurements with different antennas in the same network, eg with an antenna in the vehicle and a roof-mounted antenna. The portable TS9958V may be used in any vehicle with a 12-V onboard supply (230V supply as option) and is open-ended for future needs through sim-



ple software updates on floppy disk. An external navigation system (GPS receiver, Travelpilot or multimode navigator) may be added to supplement the integrated GPS receiver.

Test results are evaluated either by the Evaluation Software TS9954 for signalling data, the high-performance Evaluation Software OPAS for signalling and quality data or the Quality Analysis Software TS9954-NQA under EXCEL 5.0 for graphical representation of network quality data. [2470](6)

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Computer instrument catalogue

National Instruments has available its 1996 *computer-based instrumentation catalogue*. The free 624-page, full-colour catalogue describes the company's more than 500 software and hardware products used by engineers and scientists to develop integrated instrumentation systems for test and measurement based on industry-standard computers and workstations.

The catalogue includes product overviews and selection guides, and tutorials on data acquisition, GPIB, VXI and industrial automation.

The 1996 edition also features separate listings of instrument drivers by industrial I/O and test and measurement categories.

Also available is the *Instrumentation Reference and Catalogue — Academic Version* which highlights two software packages, LabVIEW and LabWindows/CVI, which instructors can use in laboratory exercises to build virtual instruments to work with or replace expensive fixed-function lab equipment.

The academic version also contains information on HiQ, the company's interactive problem solving environment for numerical analysis and data presentation.

Also highlighted are software tutorials, graphical programming instruction manuals, self-paced course kits, and videos that instructors and students can use to learn more about computer-based instrumentation. [2430](9180)

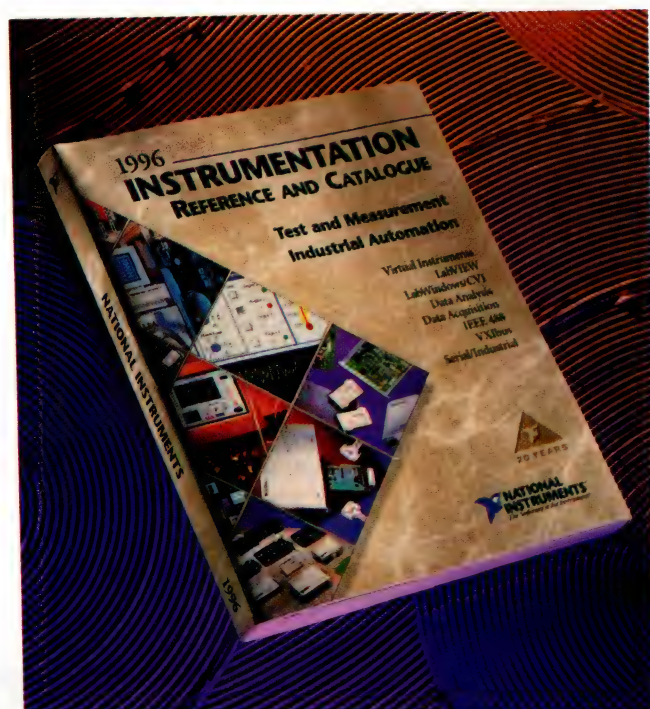
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T&M catalogue update

Wandel & Goltermann has available its 1996 *catalogue update*. The update is a supplement to the main catalogue published in early 1995. It covers new products and product features which have been released since the publication of the main catalogue.

A diskette is included with complete specifications for all products in the main catalogue and update. [2430](72)

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Electronic fuse catalogue

Available from **Philips Components** is the latest catalogue of electronic fuses, fuseholders and fuseclips from the *Bussmann* range.

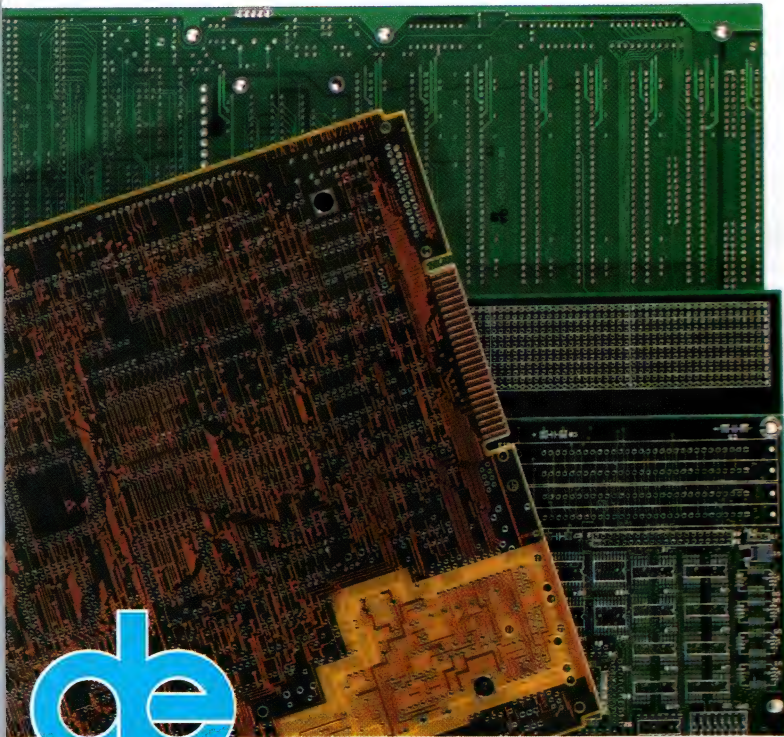
The catalogue covers the complete range of devices from surface mount, subminiature and PCB fuses up to high-capacity ferrule types, as well as the range of holders and clips for mounting. It also includes automotive and pin-indicating types, actuators and limiters, all of which are designed for electronic circuit applications.

Also included in the catalogue is a glossary of technical terms, basic design notes, and a comparison table of IEC vs North American standards for fuse rating selection. [2430](4180)

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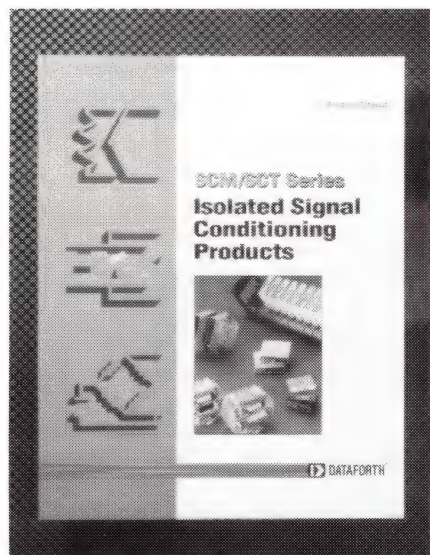
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Signal conditioning



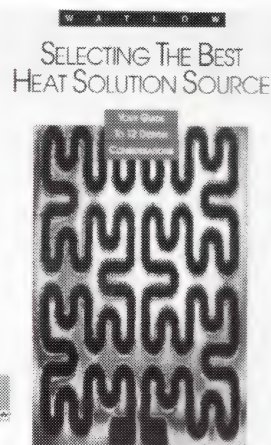
Available from **Ken-elec** is Dataforth's *SCM/SCT Series: Isolated Signal Conditioning Products catalogue* which contains over 110 pages of descriptions, specifications and applications notes for more than 400 analogue and digital I/O modules and accessories.

Included are detailed technical guides to the company's three SCM product families: SCM5B isolated analogue I/O products; SCM9B isolated intelligent I/O products;

and SCMD digital I/O products. There are also detailed descriptions of the company's new line of low-cost, high-accuracy SCT1P two-wire transmitters. [2430](4)

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Heat solutions guide



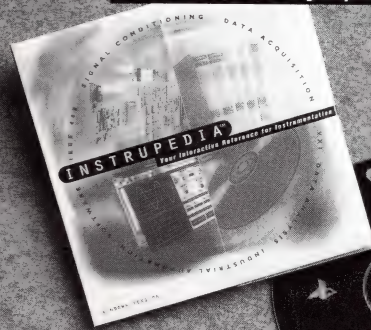
US company, **Watlow**, has released a *heat solution source guide* which features problem/solution case histories involving thermal engineering problems.

The guide contains more than 20 case studies covering areas from DNA research to annual maintenance on nuclear reactors. The studies involve a full range of heating problems and illustrate Watlow's solutions. [2430](7808)

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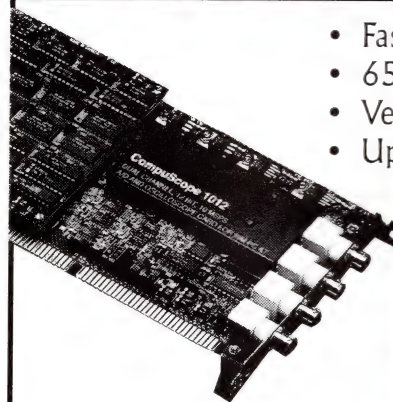
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Aspects of routability, capacity and speed in CPLDs & FPGAs

Programmable logic devices are leaping ahead in complexity and size. When selecting the right logic device for a job the designer needs to consider several factors. *Rich Kapusta* looks at some necessary considerations for using CPLDs and FPGAs.

A complex programmable logic device (CPLD) consists of multiple logic blocks that communicate with one another through a programmable, global interconnect. Each logic block is like a simple programmable logic device (PLD) — it accepts inputs, and has a product-term array and product-term allocation mechanism, macro cells, and I/O cells. For any CPLD, the number of macro cells and inputs and the way product terms are allocated are important aspects of the device, and they vary significantly from supplier to supplier.

CPLD routability

The capability of a programmable logic device depends on its resources — one major resource consideration being how signals are routed between logic blocks and I/O pins. Depending on the supplier, a CPLD's interconnect is based either on a full cross-point switch or on multiplexers.

The advantage of the cross-point switch as an interconnect is that it is completely routable — any combination of simultaneous signals can be routed to or from any logic block through the global interconnect. Two very serious disadvantages of this arrangement are that it is slow and large — to gain high flexibility of signal placement and design modification potential, and it sacrifices die size (cost) and speed.

The multiplexer-based (mux) inter-

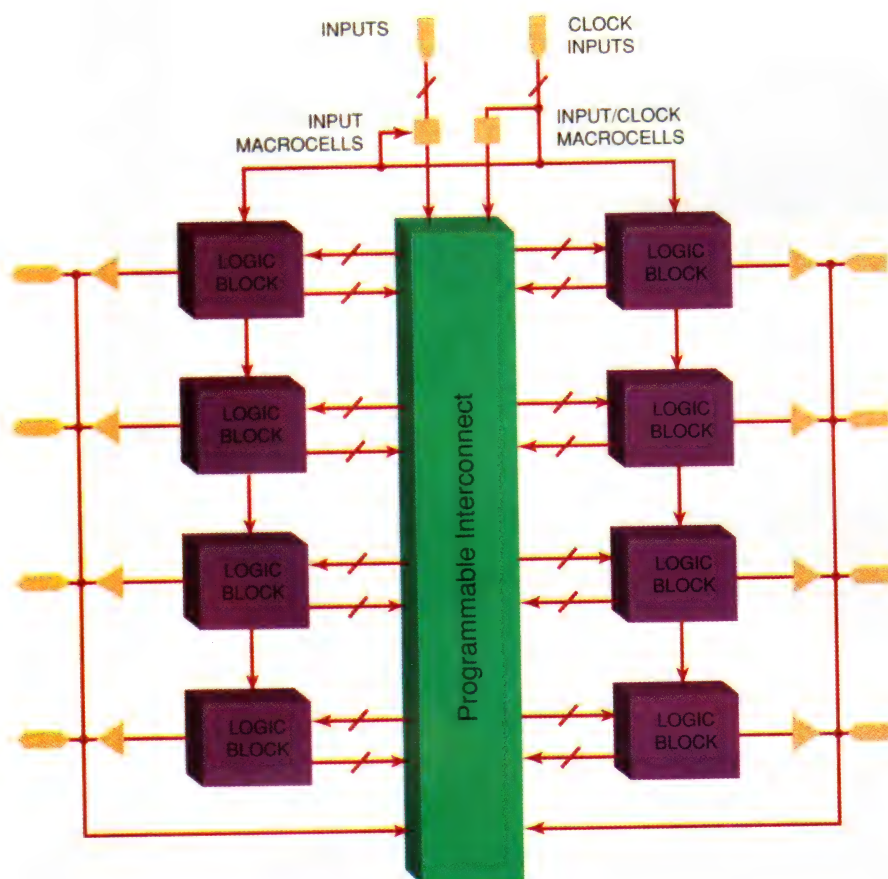


Figure 1. A CPLD consists of a limited number (usually 16 or less) of relatively large, programmable logic blocks.

connect distributes signals through muxes instead of a cross-point switch, a technique that greatly reduces interconnect size and enhances device speed. The suppliers of mux interconnect-based CPLDs implement their interconnects in different ways, and the ultimate routability of a mux-based scheme varies from supplier to supplier.

When we speak of routability we mean both the number of signals provided by the global interconnect into each logic block as well as the routability within the interconnect itself. In terms of the global interconnect capability, remember that to generate complex logic functions you may have to route many inputs into a logic block. If the maximum number of signals you can route to a logic block (via the global interconnect) is smaller than the number required for a particular logic function, then either the design will not fit or you will have to partition the design among multiple logic blocks.

A more subtle concern is routability within the interconnect, defined as the probability of finding a solution through the interconnect capable of routing all required signals into the appropriate logic blocks. Two factors make this aspect of routability a difficult one. First, as the total number of signals that must be routed into a logic block approaches the maximum, it becomes much more difficult to find a routing solution. Second, as you begin to fix the input location of these signals, it becomes harder to route them to the appropriate logic blocks.

Another, major problem can arise in some CPLDs if you have to make logic changes after a pin-out produces a successful route: the changes may cause the design to no longer fit the original pin-out. You need to be very wary of this, especially if your board has already been laid out. Some architectures have much better interconnect routability than others, and you must consider routability carefully as you select your device.

CPLD logic blocks

A second major resource to consider in determining the capability of a PLD are the characteristics of the logic blocks. What is the ability of the blocks to perform logic on a given a number of inputs? Again, the answer varies from one supplier's architecture to another's.

To get some perspective on this issue, look at the way product terms are handled by the device. A CPLD has a defined maximum number of product terms allocated to each macro cell. If a macro cell uses fewer product terms than its designated capacity, the rest of the product terms (allocated to that macro cell) may be lost if they cannot be steered to another

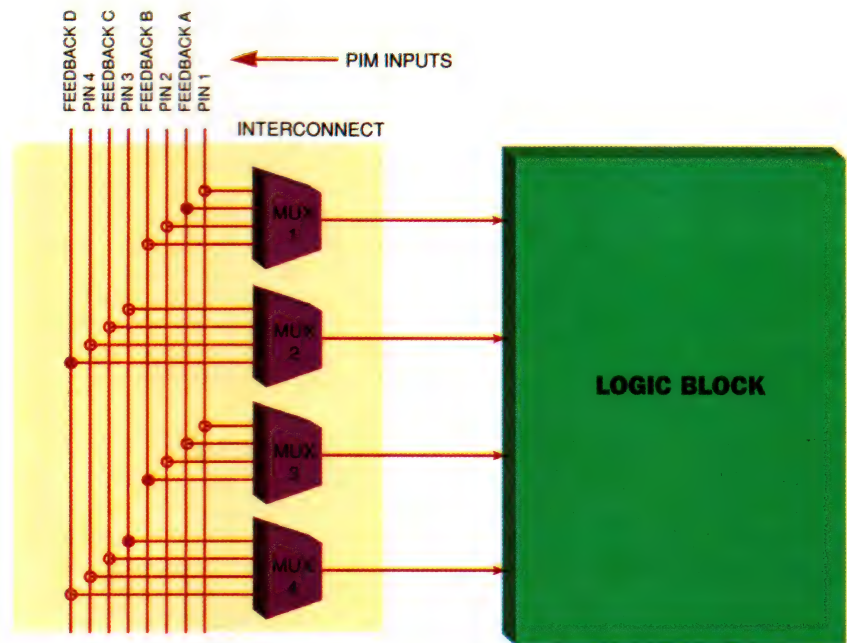


Figure 2. In this simplified example of a mux-based interconnect scheme, each input signal to the interconnect (PIM Inputs) has only two paths to each logic block (ie. two chances to route). If a logic change is made may need to reshuffle the CPLD's pinout and logic placement to satisfy the routing requirements.

er macro cell. Further, if it is not possible to share a product term among multiple macro cells, then you must duplicate its logic at every macro cell requiring that product term. The concepts of sharing and steering are highly important because they permit more efficient utilisation of device resources and enhance performance.

Different CPLD suppliers implement product term steering and sharing in different ways, however. For instance, product term steering in many CPLDs results in the moving of logic in groups — that is, if a function requires more product terms than is allocated to a particular macro cell, a collection of logic is moved from an adjacent macro cell. This increases the total amount of logic available to the needy macro cell, but it also strands the adjacent macro cell (the one borrowed from) with no logic at all. By reducing the amount of logic that would otherwise be available, this type of product term steering reduces the overall utilisation of the CPLD and wastes its resources.

Product term sharing allows logic to be implemented once, then used multiple times to generate other, more-complex functions. However, most implementations of this scheme cause a big problem — they add signal delay. The most advanced CPLDs allow the design software to steer and share single product terms as needed, without stranding macro cells or incurring any extra delay.

FPGA architectures

The architecture of a field programmable gate array (FPGA) is much different from that of a CPLD. An FPGA is a collection of logic cells that communicate with each other and with the I/O pins across an x-y grid of horizontal and vertical routing channels (wires), not through some central, global interconnect. The logic cells are typically smaller and less complex than a CPLD's logic blocks, consisting usually of a register with associated logic, and having multiple inputs and outputs. You build logic functions by connecting logic cells.

Because of the size of the logic cells, the logic in an FPGA is typically more versatile ("fine grained") than that in a CPLD, although the degree of fineness varies from supplier to supplier. In any case, the logic flexibility of an FPGA comes at a price: an FPGA cannot provide fixed delays and may be more complicated to use than a CPLD, although good design software should make such problems transparent to the user.

Any design within an FPGA typically uses one or more logic cells, an optional register, and at least two I/O pins (one of which has to lead off the chip). The ultimate performance of the design is determined by the delays imposed by the connecting wires and programmable elements, the number of logic cells cascaded, and the propagation delay of each logic cell. The achievable capacity depends upon the flexibility inherent in the logic

PROGRAMMABLE LOGIC

cells and the routability of the interconnect.

The interconnection technology used in an FPGA has a significant impact on both the delay through the interconnect and the routability through the device, and ultimately the overall performance and achievable capacity of the device. Two main types of FPGA technologies are used — SRAMs and antifuses — with each technology having its own characteristics.

An SRAM-based interconnect is very much larger than one based on antifuses. This means there are fewer possible interconnects, so an SRAM-based FPGA is much more restricted in routability than an antifuse-based FPGA. However, an SRAM-based FPGA device can be reconfigured, and some applications may require such a capability. You must decide if the loss in capacity and speed is worth it.

Antifuse and SRAM-based FPGAs also differ in the architecture of their logic cells. Although one logic cell configuration isn't inherently better than the other, the two architectures do differ importantly in the resulting granularity.

An SRAM-based FPGA is typically a coarse-grained device — meaning its logic cells tend to be large — while an antifuse-based FPGA is a fine-grained device with small logic cells. Although you can implement a given logic function in fewer cells in an SRAM FPGA, as a designer you would try to avoid traversing the interconnects as much as possible because

of the high delay they add and the small number of fuses available. The end result is that an SRAM-based FPGA severely limits your routing choices, meaning that available logic cannot be accessed.

The fine-grain architecture typical of antifuse FPGAs requires you to use more logic cells than needed in an SRAM FPGA to implement a given function. This means the fine grain of the antifuse architecture relies more heavily on the interconnect and on multiple cascaded cells. This does not imply slower performance, however, because the logic cells and interconnect are inherently fast.

Closing thoughts

Remember that, for some CPLD families, taking advantage of various architectural features will affect your design's performance, and the maximum performance rating of a device applies only to the simplest of designs. For FPGAs, it is difficult to provide specifications for parameters like propagation delay and maximum frequency, because they depend completely on the placement and routing of the design. Also, while in general an FPGA is considered to be slower than a CPLD, whether or not this is true in a given application depends on the application.

How easily you can predict the performance of a design based on its data sheet is another concern. Its predictability is tied closely to the general ease of use of a device. As a rule of thumb, the smaller the device the more predictable it is.

While CPLDs are in general somewhat less predictable than a 22V10, FPGAs are the least predictable of programmable logic devices — like some CPLDs, FPGAs force you to implement a design before you can know what its performance will be. Should predictability become an issue for you, turn to the PREP benchmarks for help, whether for CPLDs or FPGAs.

If your design demands a certain capacity, your choice is pretty much determined. But what is the true capacity of a device? A CPLDs product-term allocation scheme may cause so many macro cells to be stranded that the available density may be much smaller than the supplier-specified density. The actual usable densities of two 4,000 gate FPGAs may differ considerably. Again, a way to get reasonable assurance of actual density — and whether or not your design will fit — is to use the PREP benchmarks as a measure. □

This article was submitted by Braemac and is based in part on material prepared originally by Rich Kapusta, supervisor of Cypress's programmable-logic design tool applications group.

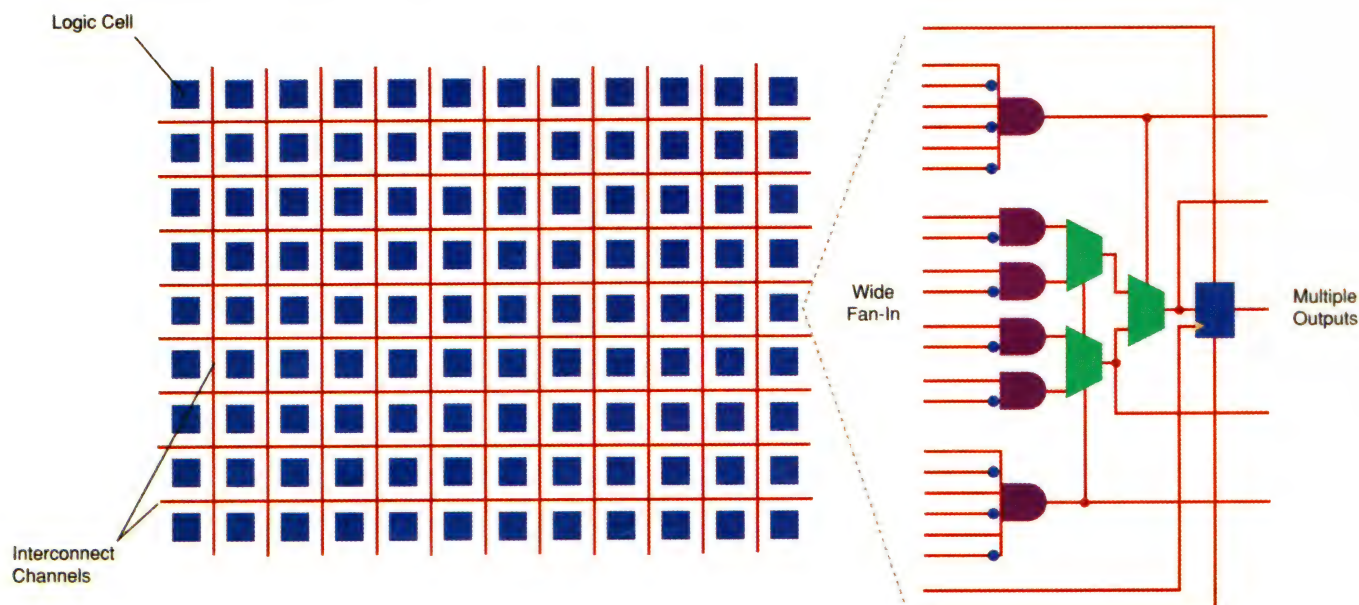
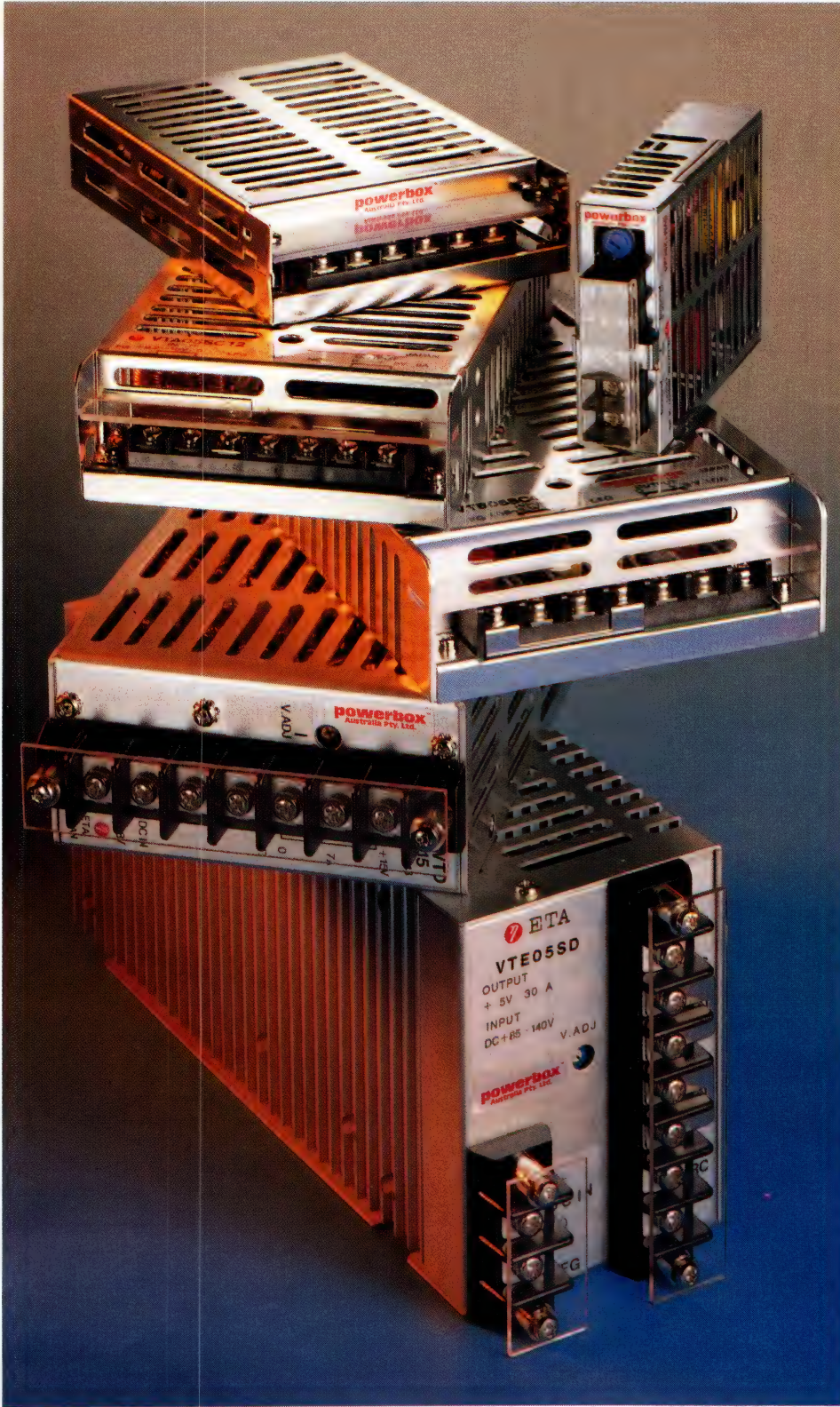


Figure 3. An FPGA has an ordered array of logic cells set into an orthogonal grid of channel-based interconnection metalization (wires). The size of the logic cells determines the granularity of the device: the smaller the cells the finer-grained and more logically flexible the device.

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Danger — very low voltage!

In an increasingly mobile world, electronic equipment must be designed to face life disconnected from the umbilical power cord. Making circuits work efficiently from the voltages typically associated with battery power can be a tricky business. Rex Niven goes low voltage.

Battery powered products need circuit supply voltages as low as possible to minimise the number of cells required. However, integrated circuits don't seem to know this. Digital integrated circuits traditionally operate from voltages of 5V, with new product lines appearing for 3.3V, while analogue circuits often have a nominal supply of $\pm 12\text{V}$. This is partly because their internal design means that the output voltage can only reliably reach within two to three volts of supply-rail voltages. For a $\pm 12\text{V}$ supply this means that

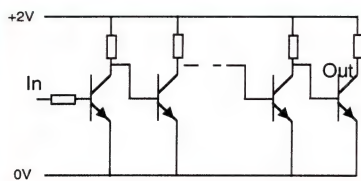


Figure 1. Basic amplifier stage.

the signal is limited to $\pm 9\text{V}$, but at $\pm 5\text{V}$ only half the total range is available. Recently circuits such as National Semiconductor's LMC660 have appeared which function well near the supply rails, even with supplies of $\pm 5\text{V}$, but below $\pm 3\text{V}$ very few products exist.

However, battery-operated systems relying on lithium batteries (end-of-life voltage of 2.0V), NiCd (end-of-life voltage of 1.0V per cell) or torch batteries (end-of-life voltage of 0.9V per cell), require many batteries in series to achieve a voltage capable of powering integrated circuits.

Designers willing to build circuits from discrete transistors will find that circuits functioning from 3V down to below 2.0V are possible, and certain inte-

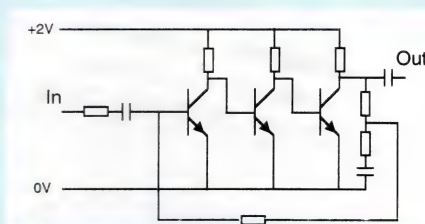


Figure 2. High-gain amplifier with feedback.

grated circuits suitable for these voltages also exist.

The use of enhancement or MOSFETs is largely excluded since a gate voltage of 2V is not usually sufficient to saturate the transistor, while JFETs can only be switched off with a negative voltage. A bipolar transistor however is saturated at a base voltage of "only" 0.7V, and switched off at less than 0.3V. In fact the dominant feature of such low voltage electronics is the V_{be} drop of 0.6V or so, which "uses" one third of the available voltage swing. Therefore only one base-emitter junction can be placed in any series circuit. A basic amplifier can be made as in Figure 1. Each intermediate collector voltage changes between

0.6V and 0.3V, but the final stage can swing between nearly the full supply range. By progressively reducing the collector resistance value along the chain of transistors, the power available at the output can reach several watts.

By using an odd number of transistors (typically 3) and adding feedback an ac-coupled amplifier of high gain (eg. 30,000) can be constructed (Figure 2).

For saturated switching it is possible to include a series transistor with the base drive resistor as in Figure 3. This has the advantage of reducing the supply current when the load is off. In theory the circuit shown could drive a relay

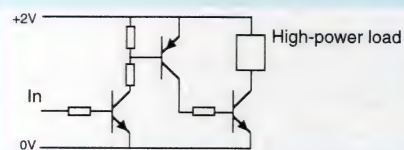


Figure 3. Circuit for high-power switching.

coil, but most commercially available relays have 3V as a minimum nominal coil voltage value, making their use at 2V marginal and only possible where the maximum temperature is close to room

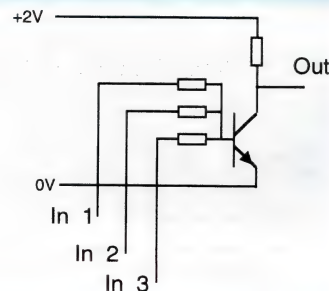
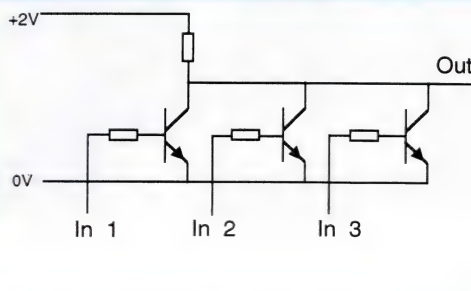
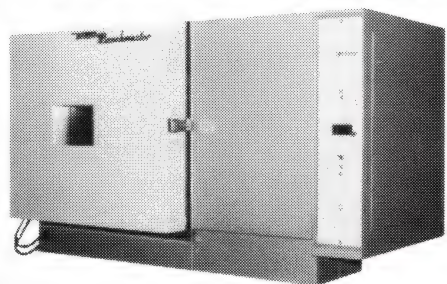


Figure 4. Circuit for a logic NOR function. The alternative circuit on the right is simpler but not recommended at low voltages.

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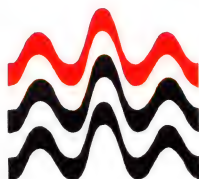
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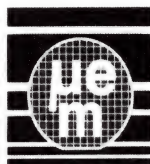
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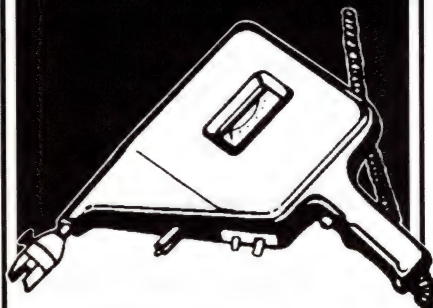
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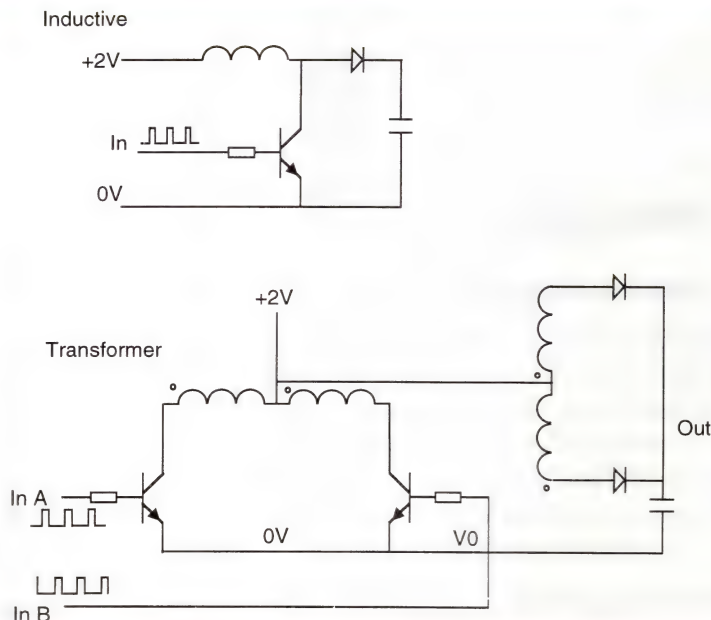


Figure 5. Voltage booster circuits using either an inductor or transformer.

temperature. There is no reason that a custom relay for voltages as low as 1V could not be designed however.

For a visual output, incandescent bulbs are available which operate from voltages as low as 2.2V (1W). Red LEDs can function using voltages as low as 1.3V, although it is difficult to control the current where the supply voltage varies over a 3V to 2V range, which is the norm for dry battery systems.

Although some logic circuits have guaranteed operation at a 2V supply, for lower voltages simple resistor logic can be implemented as shown in Figure 4. The single transistor NOR gate may not function for a single high input since the base voltage may not exceed the minimum necessary to switch the transistor. The multiple transistor version is needed for reliable operation.

Boosting the voltage to a higher level is possible using the switched-mode technique shown in Figure 5. This method is exploited by commercially available

integrated circuits such as the MAXIM MAX856. Another effective approach is a push-pull driven transformer, which can achieve a respectable efficiency of around 75%. Charge-pumps used, for example, to boost 5V to 12V for RS232 interfaces function poorly at low voltages due to the V_{ce} (or V_{ds}) losses which negate the voltage multiplication.

Integrated circuits which function at 2V include some low-power op-amps, 74HCXX logic (but not 74HCTXX or 4000 series) and special circuits such as the LED flasher LM3909 from National Semiconductor (although this consists of little more than three transistors). The low voltage op-amps are usually designed for low power also, and usually have a limited gain-bandwidth of much less than 1MHz.

An astable circuit for very low voltages can be made from transistors as shown in the circuit of Figure 6. Monostable circuits can be realised using the 74HC4538, or a modification of the circuit in Figure 6. The ubiquitous 555-type timer circuit cannot be used below about 4V.

Another advantage of discrete transistor circuits is low cost: the component cost of five transistors and ten resistors is about equivalent to a single simple integrated circuit, but provides a greater design flexibility. □

Rex Niven is manager of the Australian Photonics Cooperative Research Centre's Optoelectronic Product Development Facility, located in the Photonics Research Laboratory at the University of Melbourne.

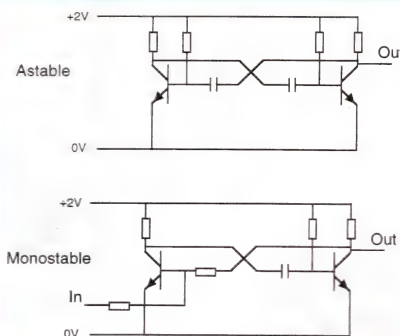
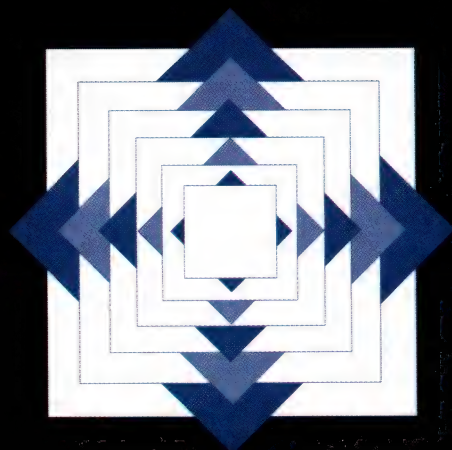
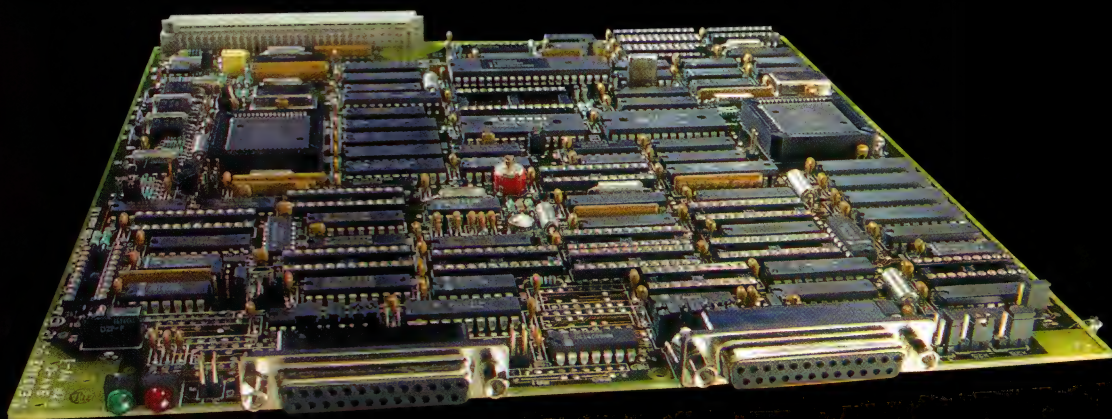
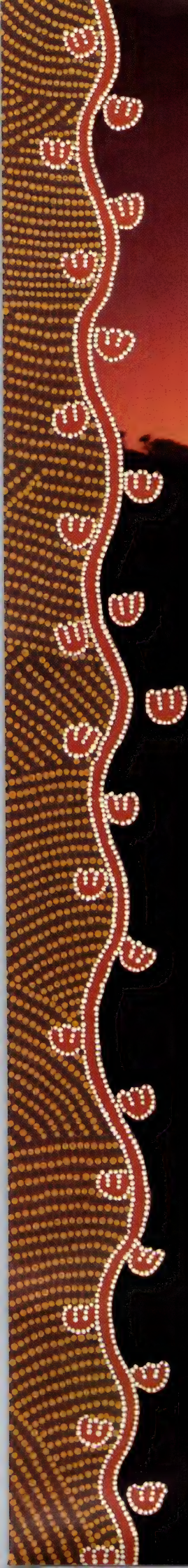


Figure 6. Astable and monostable multivibrator circuits.

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David Johnstone

Systems on silicon

David Johnstone is the hardware manager of Canon Information Systems Research Australia. He's a man who firmly believes that electronics R&D has a big future in Australia, and that integrating whole systems on a single piece of silicon is the way forward for volume production.

— By Rob Irwin

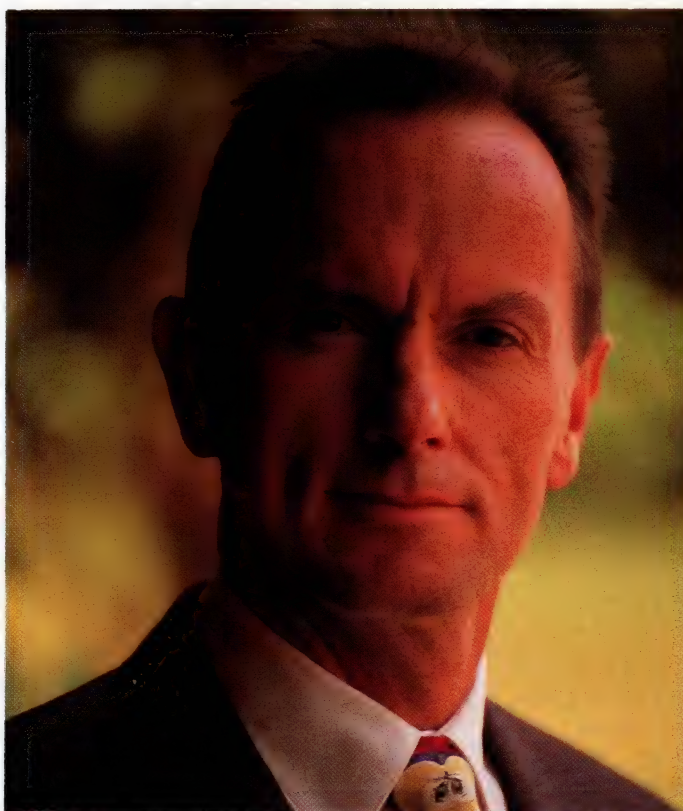
Research and development is often seen as the glamour end of the electronics industry and an area in which only the very brave or very rich dare tread. David Johnstone has been hardware manager at Canon Information Systems Research Australia (CISRA) since in 1990 and is convinced that Australia has what it takes to play the hi-tech R&D game.

David grew up in the northern NSW town of Armidale. At the age of nine, he moved with his family to Sydney and later studied electrical engineering at the University of NSW.

David has a long history with both hardware and software development. "My first job was with a company called Computer Manufacturers Australia (CMA). I was called a systems engineer and I wasn't actually doing R&D in the first three years of my career but I was working with the people in the R&D group in both writing system support software and running the lab," he recalls.

CMA were in the business of building peripheral controllers for Honeywell mini-computers. "In those days [controllers for tape and disk drives] didn't really exist, so you had to build your own interfaces," said David.

In March 1977 he started as a design engineer with a company called Ausonics. "In spite of my hardware bias I've always had some involvement in software. During the first seven years [of my career] there was a significant amount of software development. At Ausonics I was involved in software and micro-processor hardware design for one of the



world's first digital-based ultrasonic scanners," David recalls. "It was called the Digital Octoson. Ausonics made ultrasonic scanning equipment and they built an enormous full-body ultrasound scanner which consisted of an array of eight transducers embedded in a huge bath of water."

Since then ultrasound scanners have turned into quite small things and these days they're usually a single probe that you move around by hand," he said.

His work at Ausonics gave David a taste of cutting-edge R&D work. "[Ultrasonic technology] was pioneered by a group called the Ultrasonics Institute. It was a government research group here in Australia and they come up with the

original ultrasound technology which we then commercialised."

David went on to be the project leader and assistant designer of one of the world's first commercial ultrasonic breast scanning products, a state-of-the-art machine when it appeared on the market.

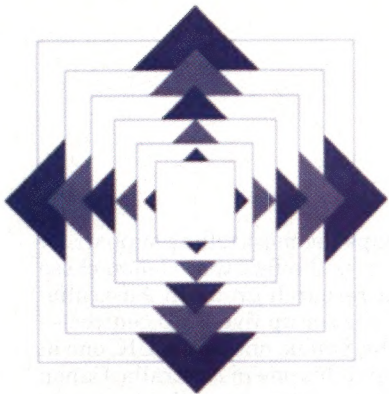
Ausonics also introduced David to VLSI development. "I guess I've always worked at the forefront of ASIC or VLSI design in Australia. There haven't been a lot of companies doing it, but I've been lucky enough to be in the organisations where it's been happening. At Ausonics in 1984 I championed three VLSI designs through CSIRO," David remembers.

The CSIRO link was part of a project to allow universities and industry to try out small IC designs by incorporating multiple projects on a single chip, thus sharing the fabrication cost. "We put three designs through the CSIRO

venture. It taught me and the people I had working for me a lot about the ins and outs of chip design," said David. "We were using what was termed then the Mead-Conway methodology. It was full custom design. You actually had to design the transistors geometrically. It was a pretty tough way to do design."

In 1986 David moved from Ausonics to head up an R&D team at a company called Impact Systems working on laser printer products. Starting with a team of about 12, David increased the R&D department over a two-year period to a group of about 50.

David's work at Impact involved him further in chip design. "At Impact Systems I managed two projects whose suc-



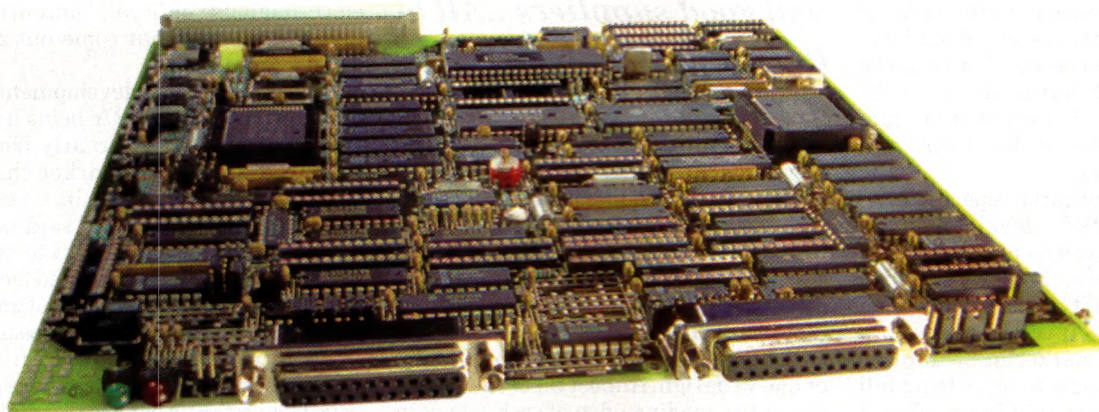
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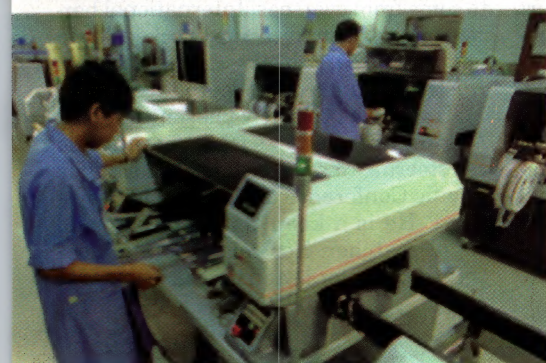
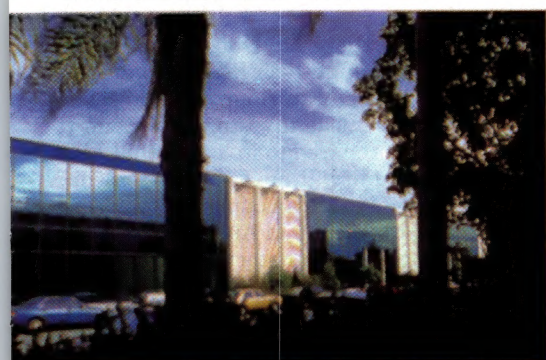
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cess relied on the development of semi-custom chips. To achieve this required setting up the very latest CAE tool environment."

When Impact Systems was taken over by Gestetner in 1988, David left and took up an opportunity to work for Austek Microsystems in Adelaide. "At that stage they were the foremost custom chip design company in Australia," said David. "The most commercially successful thing they did was design several cache controller chips for Intel x86 processors."

After a couple of years in Adelaide David found he was missing Sydney, and in August 1990 he took up an offer from CISRA and joined as hardware manager and, as at Impact, was given a mandate to put together a development team. "When I joined as hardware manager there was a small team of three hardware specialists and four software specialists. CISRA now has in the order of 25 hardware specialists and about 50 or more software specialists. I'm involved in managing both hardware and software development, but my primary contribution is focused on hardware and ASICs," said David.

David sees application specific integrated circuit (ASIC) development as integral to the success of products in today's marketplace. "I believe systems-on-silicon is the reality of hardware design for products today. If you want to get [a product] into the market in medium to high volume you have to be putting full systems onto a piece of silicon. What I mean by that is you need to put together, for example, microprocessor, RAM, ROM, I/O and custom circuitry, and in our case graphics and image processing systems or subsystems, on a single piece of silicon."

In recent times chip makers have been increasing the size and complexity of logic devices such as field programmable gate arrays (FPGAs) to the extent that they compete with low end ASICs. "I think FPGAs are interesting and I think they enable companies to get into niche areas without having the full hit of the investment of semi-custom design. You're talking about large NRE costs if you go into semi-custom," David commented.

"FPGAs have their place and they let you get into low volume [production], but if you want to get into mainstream or medium to high volume [production] then you have to be able to put a full system onto a piece of silicon. With FPGAs, the most cost effective is still less than 10,000 gates. I think the gap between FPGAs and semi-custom could well close [in the future], although semi-custom is always screaming ahead as well. I think there is a case that FPGAs will move into the

medium-volume market and be cost effective, but at the moment, and I would say for the next few years, certainly not.

"The way we use FPGAs [at CISRA] is either to rapidly prototype an architecture and look at particular timings we're not sure about before we commit ourselves to a piece of silicon, or...in a low-volume product with the possibility

"I think the secret to successful ASIC development is, particularly in Australia, that you must have good people, good methods and techniques, good tools and good suppliers...All of that is available here."

of redesigning it using an ASIC if the volume is increased."

David's enthusiasm for the integration of whole systems has driven CISRA to many successes. "CISRA has successfully developed 10 ASICs. All of them allowed fully-functional prototypes to be built using first silicon. There's a further chip currently in test and we have another one in design. Almost all of the ASICs are at the leading edge of technology in speed, complexity or size. The latest ASIC contains multiple subsystems which we would have previously only attempted as one subsystem per chip," he said.

Successfully competing in leading-edge design requires the right infrastructure and support. During a career spanning 22 years, David has developed a deep conviction that Australia has what it takes to be on the leading edge. He feels strongly that high-tech R&D is a viable industry in Australia. "I think Australia has the right infrastructure to allow that to happen. We've got good engineers and we've got good support centres," David commented. "Mentor Technologies, for example, is a very good support centre for CAE tools. There are a number of good ASIC design support centres here. The one we use is Reptechnic who support LSI Logic. The infrastructure is viable.

"I think the secret to successful ASIC development is, particularly in Australia, that you must have good people, good methods and techniques, good tools and good suppliers. You've got to have all of those and that's why I think it can be done in Australia. All of that is available here."

Perhaps the most telling support for this claim is the fact that Canon chose to site a research group in Australia. "Canon has set up five R&D centres — two in the States, one in the UK, one in France and this one in Australia. Canon picked Australia because there's a very good engineering base here. Australia has good engineers and a very good reputation for software development," said David.

Canon invests about \$10 million annually in Australia, but the benefits of the R&D go far beyond this. "Part of Canon's globalisation strategy is that if they set up an R&D centre in a particular region, then where practical, the technology should be developed and the manufacturing and marketing control should happen out of that centre. So Canon's strategy is that the benefits should go back to the country where the centre is located through use of [local] subcontractors and the exports that come out of that development.

"Obviously ASIC development has a high upfront cost. CISRA, being a Canon subsidiary, benefits greatly from the strong international market channels and the vision to invest in a very talented R&D organisation," said David.

While the infrastructure to support R&D exists in Australia, David feels that investment is still a major stumbling block. "There is the problem of post-recession cautiousness and the after-effects of the stock market crash, where people have been nervous to invest. I think there is certainly a reluctance in the Australian investment community and that's an inhibiting factor.

"I think there's also a lack of understanding of what Australia is capable of. Certainly there have been good examples where high-tech R&D can and has been successful in Australia. However, it's the overseas investors who tend to be more prepared to invest in that kind of opportunity. It needs either someone like Canon to see an opportunity in Australia or someone in Australia with the ability to sell their story to the overseas investors.

"I wouldn't exclude local investment but I think that the majority of investment dollars in the short-term will have to come from overseas. International barriers are continually being knocked down, however, and I think as that happens Australia will become more attractive."

David was recently chosen to be the Australian industry's representative on the steering committee for the IEEE Asia Pacific Conference on Circuits and Systems. He is a keen tennis player and rugby watcher. For relaxation he does cryptic crosswords and listens to music. □

Surface-mount resistors from Philips

Selection guide for chip resistors

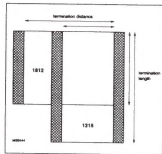
APPLICATION	TYPE	SIZE CODE	TOL. (%)	RESISTANCE RANGE	TEMP. COEFF. (× 10 ⁻⁴ /K)	MAX. (V/W)	SERIES	PAGE
Thick film								
Standard	RC01	1206	5 or 2	1 Ω to 10 MΩ	≤±200	200/0.25	E24	30
	RC11	0805		1 Ω to 10 MΩ	≤±200	150/0.1		38
	RC21	0603		1 to 10 Ω	-200/+500	50/0.063		46
				11 Ω to 910 kΩ	±200			
			1 to 6.8 MΩ	±300				
Precision TC100	RC02H	1206	1	1 to 4.99 Ω	≤±250	200/0.125	E24/96	56
	RC02HP				5.1 to 9.76 Ω	≤±200		200/0.25
				10 Ω to 1 MΩ	≤±100			
				1.02 to 10 MΩ	≤±200			
	RC12H	0805		1 to 4.99 Ω	≤±250	150/0.1		74
				5.1 to 97.6 Ω	≤±200			
				100 Ω to 1 MΩ	≤±100			
	RC22H	0603		1 to 4.99 Ω	≤±250	50/0.063		82
5.1 to 97.6 Ω			≤±200					
		100 Ω to 1 MΩ	≤±100					
Precision TC50	RC02G	1206	1	100 Ω to 1 MΩ	≤±50	200/0.125		89
	RC02GP				250 Ω to 1 MΩ	≤±50		200/0.25
	RC12G	0805		100 to 249 Ω	≤±100	150/0.1		105
				255 Ω to 1 MΩ	≤±50			
High precision	RC03G	1206	0.5	100 to 249 Ω	≤±100	200/0.125		114
			255 Ω to 1 MΩ	≤±50				
Application specific	RC02TR trimmable	1206	+0/-20 or +0/-30	1 to 4.99 Ω	≤±250	200/0.25	E24	153
				5.1 to 97.6 Ω	≤±200			
				100 Ω to 1 MΩ	≤±100			
	LRC01 low-ohmic		5	0.1 to 0.147 Ω	≤±1000	0.125	140	
				0.15 to 0.392 Ω	≤±700			
			0.4 to 0.91 Ω	≤±250				
FRC01 fusible			1 to 250 Ω	≤±200	200/0.125	146		
PRC201 power	1218	5	1 to 9.1 Ω	≤±200	200/1	130		
			10 Ω to 1 MΩ	≤±100				
Thin film								
High precision	MPC01	1206	0.1	100 Ω to 100 kΩ	≤±25	100/0.125	all values	122

Smallest power chip resistor dissipates 1W

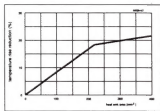
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Layout of a Philips' size 1218 PRC201 power chip compared with a standard size 1812 chip.



Temperature rise reduction of the solder spot as a function of a heatsink area added on the underside of an FR4 PC board.

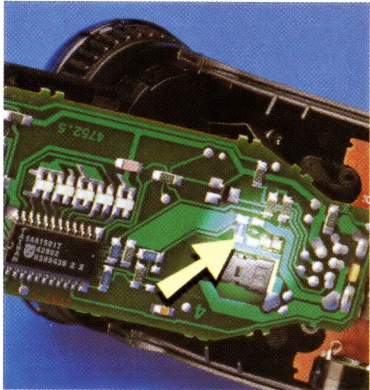
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Low ohmic resistors have up to now, been expensive ultra high precision, ultra low TCR leaded products intended for current sensing in professional products. As it is the low ohmic feature and not ultra high precision which is required, Philips have identified this need and released the LRC01 series.

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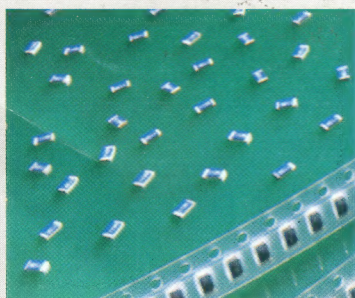


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